USDA United States Department of Agriculture

Forest Service

Northeastern Research Station

Research Attainment Report

Fiscal Year 2000

RESEARCH ATTAINMENT REPORT

FISCAL YEAR 2000

United States Department of Agriculture
Forest Service
Northeastern Research Station

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Research Work Unit Attainment Reports

Wildlife, Fish, Water, and Air Research (Continued)

PART I: RESEARCH WORK UNIT ATTAINMENT REPORTS

INTRODUCTION

The Research Work Unit Attainment Reports in Part I each begin with a Research Work Unit Summary. This summary is in the form of a table, listing the problem number and title, the current level of funding, the current staffing (scientist years) and a tally of the number of publications produced, whether in the work unit, through extramural research, or through cooperative research.

The Research Work Unit Summary is followed by further information for each problem giving the attainments for a single problem. These reports give bibliographic information on each publication resulting from the research on a particular problem, plus a narrative summary of the attainment for that problem.

Part II is a bibliography of all the publications produced as a result of research conducted by the Northeastern Research Station in Fiscal Year 2000, listed in alphabetical order.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4103

The Role of Environmental Stress on Tree Growth and Development
Tyree, Melvin T, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Measure physiological performance of trees following stress and evaluate mechanisms leading to health declines	580	2	13	0	1
2. Towards a better understanding of water-stress physiology: hydraulic sufficiency of stems to conduct water to leaves	290	1	1	9	0

NORTHEASTERN RESEARCH STATION
Research Unit NE-4103

Problem 1 Measure physiological performance of trees following stress and evaluate mechanisms leading to health declines

Publications

Research

Borer, C.H.; Schaberg, P.G.; DeHayes, D.H.; Hawley, G.J. 2000. Physiological implications of anthropogenic environmental calcium depletions. In: Labrecque, Michel, chairman. The tree biology and development: 4th international symposium on the tree; 2000 August 20-26; Montreal PQ. Montreal, PQ: Montreal Botanical Garden: 22. Abstract.

DeHayes, Donald H.; Jacobson, George L., Jr.; Schaberg, Paul G.; Bongarten, Bruce; Iverson, Louis; Dieffenbacher-Krall, Ann C. 2000. Forest responses to changing climate: lessons from the past and uncertainty for the future. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 495-540.

Hawley, G.J.; DeHayes, D.H.; Schaberg, P.G. 2000. Calcium depletion: a threat to forest health and sustainability? In: Ing. Romarico Arroyo Marroquin, ed. 16th North American forest biology workshop; 2000 July 17-21; Yucatan, Mexico. 9 #514 por 6 y 64. Merida, Yucatan, Mexico: Auditono de la Secretario de Desarrollo, Industrial y Commercial: 86. Abstract.

Hawley, G.J.; DeHayes, D.H.; Schaberg, P.G. 2000. Genetic diversity and restoration of a disjunct pitch pine population in Vermont, U.S.A. In: Ing. Romarico Arroyo Marroquin, ed. 16th North American forest biology workshop; 2000 July 17-21; Yucatan, Mexico. 9 #514 por 6 y 64. Merida, Yucatan, Mexico: Auditono de la Secretario de Desarrollo, Industrial y Commercial: 85. Abstract.

Perkins, T.D.; Adams, G.T.; Lawson, S.T.; Schaberg, P.G.; McNulty, S.G. 2000. Long-term nitrogen fertilization increases winter injury in montane red spruce (Picea rubens) foliage. Journal of Sustainable Forestry. 10(1/2): 165-172.

Perkins, T.D.; Adams, G.T.; Lawson, S.T.; Schaberg, P.G.; McNulty, S.G. 2000. Long-term nitrogen fertilization increases winter injury in montane red spruce (Picea rubens) foliage. In: Mitchell, Alan K.; Puttonen, Pasi; Stoehr, Michael; Hawkins, Barbara J., comps., eds. Frontiers of forest biology: proceedings of the 1998 joint meeting of the North American forest biology workshop and the western forest genetics association. New York, NY: The Haworth Press, Inc.: 165-172.

Schaberg, P.G.; DeHayes, D.H.; Hawley, G.J. 2000. Is calcium depletion a threat to forest ecosystem health? In: Costanza, Robert, chair. EcoSummit 2000: integrating the sciences: understanding and solving environmental problems in the 21st century; 2000 June 18-22; Halifax, Nova Scotia, Canada. Oxford, UK: Elsevier Science: 242. Abstract.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4103

Research

Schaberg, P.G.; DeHayes, D.H.; Hawley, G.J.; Strimbeck, G.R.; Cumming, J.R.; Murakami, P.E.; Borer, C.H. 2000. Acid mist and soil Ca and Al alter the mineral nutrition and physiology of red spruce. Tree Physiology. 20: 73-85.

Schaberg, P.G.; Snyder, M.C.; Shane, J.B.; Donnelly, J.R. 2000. Seasonal patterns of carbohydrate reserves in red spruce seedlings. Tree Physiology. 20: 549-555.

Schaberg, P.G.; Strimbeck, G.R.; Hawley, G.J.; DeHayes, D.H.; Shane, J.B.; Murakami, P.F.; Perkins, T.D.; Donnelly, J.R.; Wong, B.L. 2000. Cold tolerance and photosystem function in a montane red spruce population: physiological relationships with foliar carbohydrates. In: Mitchell, Alan K.; Puttonen, Pasi; Stoehr, Michael; Hawkins, Barbara J., comps., eds. Frontiers of forest biology: proceedings of the 1998 joint meeting of the North American forest biology workshop and the western forest genetics association. New York, NY: The Haworth Press, Inc.: 173-180.

Schaberg, P.G.; Strimbeck, G.R.; Richard; Hawley, G.J.; DeHayes, D.H.; Shane, J.B.; Murakami, P.F.; Perkins, T.D.; Donnelly, J.R.; Wong, B.L. 2000. Cold tolerance and photosystem function in a montane red spruce population: physiological relationships with foliar carbohydrates. Journal of Sustainable Forestry. 10(1/2): 173-180.

Schaberg, Paul G.; DeHayes, Donald H. 2000. Physiological and environmental causes of freezing injury in red spruce. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Response of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 181-227.

van den Berg, Abby; Donnelly, John; Schaberg, Paul; Murakami, Paula. 2000. Development of fall foliage color in sugar maple. In: Labrecque, Michel, chairman. The tree biology and development: 4th international symposium on the tree; 2000 August 20-26; Montreal, PQ. Montreal, PQ: Montreal Botanical Garden: 39-40. Abstract.

Cooperative

Fast, Jerome D.; Heilman, Warren E. 2000. Simulations of ozone in the Great Lakes Region. In: 24th conference on agricultural and forest meteorology; 14th conference on biometeorology and aerobiology; 2000 August 14-18; Davis, CA. Boston, MA: American Meteorological Society: 176-177.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4103

Attainment

We have verified that acid rain can leach calcium (Ca) from red spruce foliar cell membranes, destabilizing them and making them more vulnerable to freezing injury (3 manuscripts). We are now assessing if soil-based Ca disturbance can similarly disrupt membrane-associated Ca (mCa), alter physiology, and compromise tree health (2 manuscripts). Procedures are also being developed to apply mCa techniques to test if Ca depletion may be a predisposing factor in maple decline. In a separate study we are evaluating the physiology of fall foliage color development, a phenomenon that is of great public interest and of direct financial importance to tourism throughout New England. Other work is examining how tree carbon reserves influence the response of maples to stress. For example, two studies were established to determine the effect of the massive January 1988 ice storm on carbohydrate reserves and tree health. We are also assessing how crown dieback influences winter carbon storage, tree growth, and survival.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4103

Problem 2 Towards a better understanding of water-stress physiology: hydraulic sufficiency of stems to conduct water to leaves

Publications

Research

Tyree, M.T. 1999. The forgotten component of plant water potential: a reply - tissue pressures are not additive in the way M. J. Canny suggests. Plant Biology. 1: 598-601.

Extramural

Engelbrech, T.; Bettina, M.J.; Velez, Virginia; Tyree, Melvin T. 2000. Hydraulic conductance of two co-occurring neotropical understory shrubs with different habitat preferences. Annals of Forest Service. 57: 201-208.

Nardini, Andrea; Salleo, Sebastiano; Tyree, Melvin T.; Vertovec, Moreno. 2000. Influence of the ectomycorrhizas formed by Tuber melanosporum Vitt. on hydraulic conductance and water relations of Quercus ilex L. seedlings. Annals of Forest Science. 57: 305-312.

Patino, Sandra; Gilbert, Gregory S.; Zotz, Gerhard; Tyree, Melvin T. 1999. Growth and survival of aerial roots of hemiepiphytes in a lower montane tropical moist forest in Panama. Journal of Tropical Ecology. 15: 651-665.

Rood, Stewart B.; Patino, Sandra; Coombs, Krista; Tyree, Melvin T. 2000. Branch sacrifice: cavitation-associated drought adaptation of riparian cottonwoods. Trees. 14: 248-257.

Tsuda, Makoto; Tyree, Melvin T. 2000. Plant hydraulic conductance measured by the high pressure flow meter in crop plants. Journal of Experimental Botany. 51(345): 823-828.

Turner, M.; Lucas, P.W.; Becker, P.; Wong, S.C.; Yong, J.W.H.; Choong, M.F.; Tyree, M.T. 2000. Tree leaf form in Brunei: a heath forest and mixed dipterocarp forest compared. Biotropica. 32(1): 53-61.

Wei, C.; Tyree, M.T.; Bennink, J.P. 2000. The transmission of gas pressure to xylem fluid pressure when plants are inside a pressure bomb. Journal of Experimental Botany. 51(343): 309-316.

Wei, Chunfang; Tyree, Melvin T.; Steudle, Ernst. 1999. Direct measurement of xylem pressure in leaves of intact maize plants. A test of the cohesion-tension theory taking hydraulic architecture into consideration. Plant Physiology. 121: 1191-1205.

Zotz, Gerhard; Pantino, Sandra; Tyree, Melvin T. 1997. CO2 gas exchange and the occurrence of CAM in tropical woody hemiepiphytes. Flora. 192: 143-150.

Attainment

The NSF project on Psychotria species in the neotropics (Panama), which was started in May 1997, has been extended for another 9 months. The Forest Service contribution to the program concerns the water relations of Psychotria species and computer model development. We are currently writing papers from the 4-year project. We also spent 4 months writing a Windows 98 program (T-Plant) which models for the light interception, photosynthesis, hydraulic architecture and growth of the species. The program was also modified at the request of our collaborators in Italy to model for the hydraulic architecture of individual leaves. Dr. S. Cohen (from Israel) spent the summer in our lab doing experiments to validate the water-use predictions of T-Plant and to permit us to write a new grant proposal - BARD. This proposed research will look at the effects of root physiology on crown performance by studying trees grafted to various root-stocks.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4104

Measurement, Analysis, and Modeling of Forest Ecosystems in a Changing Environment
Solomon, Dale S, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Mechanistic analyses need to be advanced to reduce uncertainty about the consequences of ecosystem management alternatives and to assess the consequences of a changing environment	180	2.5	5	0	0
2. Techniques to scale up biophysical processes from the levels of organs and organisms to ecosystems and landscapes need to be developed	180	2	3	1	1
3. Knowledge of underlying processes must be integrated into operational tools to provide quantitative methods for adaptively managing our forest ecosystems	180	1.5	7	0	3

NORTHEASTERN RESEARCH STATION
Research Unit NE-4104

Problem 1 Mechanistic analyses need to be advanced to reduce uncertainty about the consequences of ecosystem management alternatives and to assess the consequences of a changing environment

Publications

Research

Green, Edwin J.; MacFarlane, David W.; Valentine, Harry T. 2000. Bayesian synthesis for quantifying uncertainty in predictions from process models. Tree Physiology. 20(5/6): 415-419.

Green, Edwin J.; MacFarlane, David W.; Valentine, Harry T.; Strawderman, William E. 1999. Assessing uncertainty in a stand growth model by Bayesian synthesis. Forest Science. 45(4): 528-538.

Hoover, Coeli M.; Birdsey, Richard A.; Heath, Linda S.; Stout, Susan L. 2000. How to estimate carbon sequestration on small forest tracts. Journal of Forestry. 98(9): 11-17.

Valentine, Harry T. 1999. Estimation of the net primary productivity of even-aged stands with a carbon-allocation model. Ecological Modelling. 122: 139-149.

Valentine, Harry T.; Amateis, Ralph L.; Burkhart, Harold E.; Gregoire, Timothy G.; Hollinger, David Y.; MacFarlane, David W. 1999. Projecting the growth of loblolly pine in a changing atmosphere. Southern Journal of Applied Forestry. 23(4): 212-216.

Valentine, Harry T.; Herman, David A.; Gove, Jeffrey H.; Hollinger, David Y.; Solomon, Dale S. 2000. Initializing a model stand for process-based projection. Tree Physiology. 20(5/6): 393-398.

Attainment

The initial version AMORPHYS, a metabolically based model of forest growth that affords assessment of the effects of management and environmental changes has been completed and is expanded as a basis for inclusion of more specific and interactive growth processes. Analyses were conducted with PIPESTEM to estimate the effects of increasing atmospheric carbon dioxide on the growth of loblolly pine plantations in the next 20-50 years. A significant increase in yield (over 6 percent) is expected in 25 years. Bayesian synthesis methods were advanced to bound projection errors of process-based models of forest growth and development. The method incorporates information internal to the model and all available external information. The method is expected to be generally applicable to mechanistic or process-based models.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4104

Problem 2 Techniques to scale up biophysical processes from the levels of organs and organisms to ecosystems and landscapes need to be developed

Publications

Research

Eav, Bov Bang; Birdsey, Richard A.; Heath, Linda S. 2000. The Kyoto Protocol and forestry practices in the United States. In: Krishnapillay, Baskaran; Soepadmo, E.; Arshad, Najib Lotfy: [and others], eds. XXI IUFRO World Congress: sub-plenary sessions; 2000 August 7-12; Kuala Lumpus, Malaysia. Kuala Lumpus, Malaysia: Malaysian XXI IUFRO World Congress Organizing Committee: 566-576.

Hall, Graeme M.J.; Hollinger, David Y. 2000. Simulating New Zealand forest dynamics with a generalized temperate forest gap model. Ecological Applications. 10(1): 115-130.

Heath, Linda S.; Smith, James E. 2000. An assessment of uncertainty in forest carbon budget projections. Environmental Science & Policy. 3: 73-82.

Hollinger, D.Y.; Goltz, S.M.; Davidson, E.A.; Lee, J.T.; Tu, K.; Valentine, H.T. 1999. Seasonal patterns and environmental control of carbon dioxide and water vapour exchange in an ecotonal boreal forest. Global Change Biology. 5(8): 891-902.

McWilliams, William H.; Heath, Linda S.; Reese, Gordon C.; Schmidt, Thomas L. 2000. Forest resources and conditions. In: Mickler, Robert A., Birdsey, Richard A.; Hom, John. comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 3-26.

Cooperative

Birdsey, Richard A.; Mickler, Robert A.; Hom, John; Heath, Linda S. 2000. Summary of prospective global change impacts on northern U.S. forest ecosystems. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 543-568.

Extramural

Canadell, J.G.; Mooney, H.A.; Baldocchi, D.D.; Berry, J.A.; Ehleringer, J.R.; Field, C.B. 2000. Carbon metabolism of the terrestrial biosphere: a multitechnique approach for improved understanding. Ecosystems. 3: 115-130.

Attainment

A long-term study of forest carbon and water exchange is continuing in a spruce-hemlock forest in northern Maine. Cooperators include the University of Maine and the Woods Hole Research Center. The study is part of the AmeriFlux network of eddy covariance research sites investigating forest carbon storage. A recent inventory of forest biomass supports the eddy flux measurements which indicate about two tons of carbon are being stored per hectare by this forest each year. New extramural support for this project was secured from the Department of Energy which will allow investigations into the consequences on forest carbon storage of typical harvest operations performed by the International Paper Co. as well as the impact of anthropogenic nitrogen inputs. New additional collaborators for this work include International Paper Co., the University of New Hampshire, the University of Georgia, and the University of Colorado.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4104

Attainment

Modeling techniques are being updated and expanded to include tree-level USDA Forest Service inventory data in a modeling framework to produce U.S. forest carbon budget estimates national scale. In addition, uncertainty analysis methodology was explored and developed to produce estimates of uncertainty about the carbon numbers. Recent results suggest that timberland in the United States is currently sequestering about 310 million metric tons of carbon per year, plus/minus 10% at the 80% confidence level. Several component-level (for example, biomass, forest floor) studies are completing final analysis. New studies on carbon in deadwood were initiated.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4104

Problem 3 Knowledge of underlying processes must be integrated into operational tools to provide quantitative methods for adaptively managing our forest ecosystems

Publications

Research

Carpenter, C.A.; Cooksey, R.; Heath, L.; Luther, T.; McLellan, T.; Peterson, F.; Raimo, D.; Schmidt, T.L.; Twardus, D. 2000. Criteria and indicator based assessment in the northeastern United States. In: Eckhoff, Janet D., ed. 2nd North American forest ecology workshop: forest ecology into the next millennium: putting the long view into practice; 1999 June 27-30; Orono, ME. Orono, ME: University of Maine: 76. Abstract.

Ducey, Mark J.; Gove, Jeffrey H. 1999. Downed wood as seedbed: measurement and management guidelines. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. GTR NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 34-42.

Gove, J.H.; Ducey, M.J.; Valentine, H.T. 1999. Multistage point relascope and randomized branch sampling for downed coarse woody debris estimation. In: Eckhoff, Janet D., ed. 2nd North American forest ecology workshop: forest ecology into the next millennium: putting the long view into practice; 1999 June 27-30; Orono ME. Orono, ME: University of Maine: 106. Abstract.

Gove, Jeffrey H. 2000. Some observations on fitting assumed diameter distributions to horizontal point sampling data. Canadian Journal of Forest Research. 30: 521-533.

Gove, Jeffrey H.; Ringvall, Anna; Stahl, Goran; Ducey, Mark J. 1999. Point relascope sampling of downed coarse wood debris. Canadian Journal of Forest Research. 29(11): 1718-1726.

Gregoire, Timothy G.; Valentine, Harry T. 1999. Composite and calibration estimation following 3P sampling. Forest Science. 45(2): 179-185.

Solomon, D.S.; Zhang L. 1999. Forest management guides based on ecological classifications. In: Eckhoff, Janet D., ed. 2nd North American forest ecology workshop: forest ecology into the next millennium: putting the long view into practice; 1999 June 27-30; Orono, ME. Orono, ME: University of Maine: 197. Abstract.

Cooperative

Brissette, J.C.; Ducey, M.J.; Gove, J.H. 1999. A field test of point relascope sampling of coarse woody material in managed stands in the Acadian forest. In: Eckhoff, Janet D., ed. 2nd North American forest ecology workshop: forest ecology into the next millennium: putting the long view into practice; 1999 June 27-30; Orono, ME. Orono, ME: University of Maine: 73. Abstract.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4104

Cooperative

Solomon, Dale S.; Leak, William B. 2000. Application of silvicultural systems in northern New England forests. In: Proceedings of the Society of American Foresters 1999 national convention; 1999 September 11-15; Portland, OR. SAF Publ. 001. Bethesda, MA: Society of American Foresters: 255-261.

Solomon, Dale S.; Leak, William B. 1999. Growth and stocking of eastern hemlock (Tsuga canadensis) in New England. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 43-49.

Attainment

The project developed forest growth model FIBER has been expanded to project growth and established sustainable yield estimates for the northern New England States of NH, VT, NY, and ME. Realistic yield estimates based on ecological classification of FIA plots across the region are the foundational basis for determining forest sustainable criteria. Silviculture practices, growth estimates, and management guides have been expanded to provide reliable estimates of northern hardwoods and softwood stands across the northern New England region.

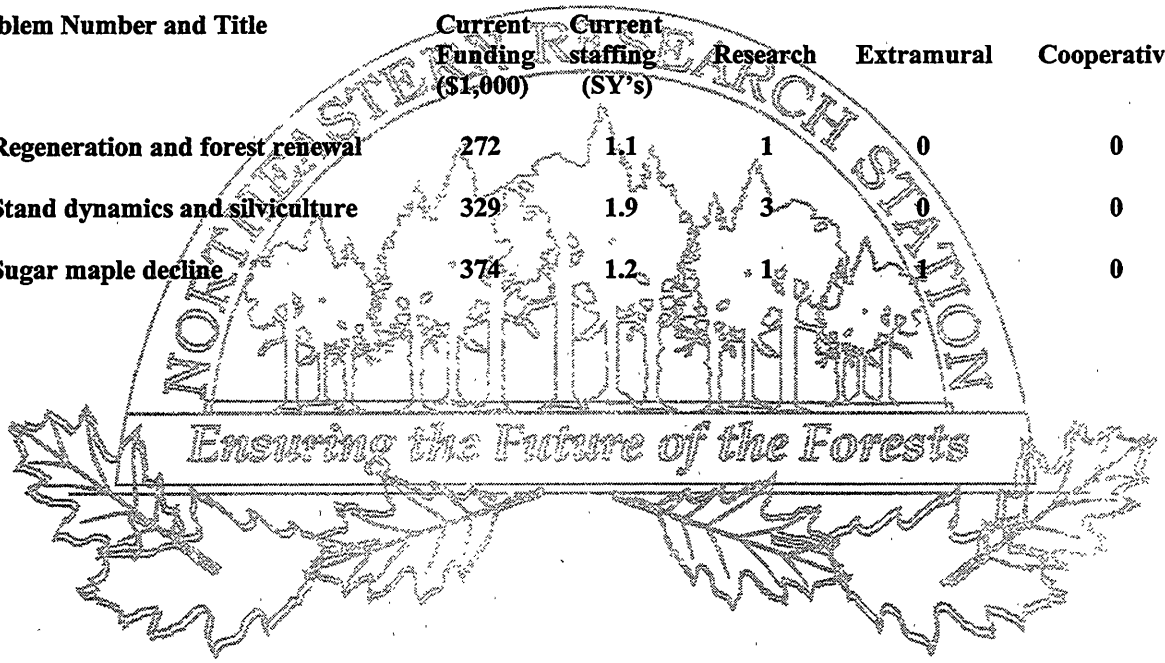
A new method has been developed for the unbiased estimation of the amount and distribution of down coarse woody debris in forest stands. The method is based on angle gauge sampling and is closely associated with horizontal point sampling (HPS) for standing trees. In fact, "point relascope sampling" (PRS") can be overlayed directly onto the sampling points taken with a prism using HPS for the standing crop, yielding a compatible technique for down material. In addition, methods for fitting diameter distributions to HPS data have been developed for modeling purposes. These methods also extend to distributions of length and diameter for down material taken by PRS.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4152

Understanding and Managing Forest Ecosystems of the Allegheny Plateau Region
Stout, Susan L, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Regeneration and forest renewal	272	1.1	1	0	0
2. Stand dynamics and silviculture	329	1.9	3	0	0
3. Sugar maple decline	374	1.2	1	1	0



NORTHEASTERN RESEARCH STATION
Research Unit NE-4152

Problem 1 Regeneration and forest renewal

Publications

Research

Brose, Patrick H.; Van Lear, David H.; Keyser, Patrick D. 1999. A shelterwood-burn technique for regenerating productive upland oak sites in the Piedmont Region. Southern Journal of Applied Forestry. 23(3): 158-163.

Attainment

We began to increase our attention to oak regeneration problems, and the potential role of prescribed fire in solving those problems. Pat Brose, our new silviculturist, has studied shelterwood-prescribed burn techniques for regenerating oaks in the south. Our other accomplishments this year occurred primarily in an expanding database of information about herbaceous and woody plant, songbird, small mammal, and amphibian communities in managed forests. We collected data on these communities in treated and control plots in the 6th year after treatment of a study of the impacts of herbicide-shelterwood and shelterwood-herbicide treatments on non-target organisms. This year, we collected data on grasses and sedges to the species level. We initiated a new study to remeasure herbaceous and woody plants in the understory of the Hearts Content Scenic Area, a remnant old-growth community on the Allegheny National Forest. To make these remeasurements, we relocated plots established originally in 1929. The results of this study will enhance our understanding of survival and restoration strategies of herbaceous species exposed to large-scale environmental influences, such as white-tailed deer browsing, exotic diseases, air pollution, recreational use, invasive plant species, and others. We also continued measurements of regeneration and herbaceous plant communities in stands managed under uneven-age silvicultural systems and stands with sugar maple decline.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4152

Problem 2 Stand dynamics and silviculture

Publications

Research

Hoover, C.M.; Birdsey, Richard A.; Heath, Linda S. 2000. Constructing standing carbon budgets for individual forests: can forest inventory and analysis data provide a shortcut? In: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 122. Abstract.

Hoover, Coeli M.; Birdsey, Richard A.; Heath, Linda S.; Stout, Susan L. 2000. How to estimate carbon sequestration on small forest tracts. Journal of Forestry. 98(9): 11-17.

Stout, Susan L.; Nelson, Jim; Rumpf, Bob; Bauer, Bob. 2000. Twentieth century forestry in Pennsylvania. Pennsylvania Forests. 91(1): 9-14.

Twery, Mark J.; Rauscher, H. Michael; Bennett, Deborah J.; Thomasma, Scott A.; Stout, Susan L.; Palmer, James F.; Hoffman, Robin E.; DeCalesta, David S.; Gustafson, Eric; Cleveland, Helene; Grove, J. Morgan; Nute, Donald; Kim, Geneho; Kollasch, R. Peter. 2000. NED-1: integrated analyses for forest stewardship decisions. Computers and Electronics in Agriculture. 27(1-3): 167-193.

Attainment

The accomplishments for this problem are improved guidelines to help land and resource managers achieve sustainable management. By placing management in an historic context, we sharpen our focus on what's new about today's challenges. By integrating our understanding across multiple disciplines, we come to appreciate better the trade-offs that land and resource managers must make, and we can better support them in making those trade-offs. Thus, our on-going research about the integrated management of white-tailed deer and forests continues to produce new insights, and these and other research results are incorporated into the NED-1 decision model. Finally, we have produced guidelines that will allow landowners and managers to calculate carbon budgets for their forests and their forest management plans, and we have shown the differences between such management unit-specific carbon budgets and those produced from more regional forest inventory data.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4152

Problem 3 Sugar maple decline

Publications

Research

Horsley, Stephen B.; Long, Robert P.; Bailey, Scott W. 2000. Herbaceous flora as indicators of sugar maple site quality. In: 16th North American forest biology workshop; 2000 July 17-21; Merida, Yucatan, Mexico [Place of publication unknown]: [Publisher name unknown]: 83. Abstract.

Cooperative

Bailey, S.W.; Horsley, S.B.; Long, R.P.; Hallett, R.A. 1999. Influence of edaphic and geologic factors on the health of sugar maple on the Allegheny Plateau. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 302. Abstract.

Hallett, R.A.; Bailely [Bailey], S.W.; Horsley, S.B.; Long, R.P. 1999. Sugar maple nutrition and health in the northeastern United States. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Long, R.P.; Horsley, S.B.; Bailey, S.W.; Lilja, P.R. 1999. Base cation additions increase growth and vigor of overstory sugar maple. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Extramural

Drohan, Patrick Joseph. 2000. A study of sugar maple (Acer saccharum Marsh) decline during 1979 to 1989 in northern Pennsylvania. The Pennsylvania State University: Ph.D. Dissertation. 184.

Attainment

Research under this problem is conducted in an interdisciplinary and cooperative way with scientists from other NE Research Work Units and universities. We continue to refine our understanding of the relationships among soil nutrients, especially base cations, edaphic and geologic factors, sugar maple health, and herbaceous plant indicators of site nutrient quality. We provided a regional overview of sugar maple health and nutrition, and moved towards providing managers with maps and indicator species tools for improving the relationship between management choices and site conditions. Finally, results from a GIS-based study of sugar maple health across the northern tier of Pennsylvania added some insights about soil physical properties to our growing understanding of sugar maple decline.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4153

Quantitative Methods for Modeling and Monitoring Response of NE Forest Ecosystems to Management and Environmental Stresses
Yaussy, Daniel A, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Managers need improved methods for predicting natural communities and their response to management and disturbance	370	1.5	8	1	3
2. Ecosystem management practices must be developed to meet demand for sustainability while providing timber products	269	1	4	2	1
3. Integrated methods of monitoring forest ecosystems are needed for sustainability and scientific understanding	176	.5	4	2	0

NORTHEASTERN RESEARCH
Research Unit NE-4153

Problem 1 Managers need improved methods for predicting natural communities and their response to management and disturbance

Publications

Research

Hutchinson, Todd F.; Boerner, Ralph E.J.; Iverson, Louis R.; Sutherland, Steve; Sutherland, Elaine Kennedy. 1999. Landscape patterns of understory composition and richness across a moisture and nitrogen mineralization gradient in Ohio (U.S.A.) Quercus forests. Plant Ecology. 144: 177-189.

Iverson, L.R.; Prasad, A.M.; Schwartz, M.W. 2000. Potential changes in tree species and forest communities with climate change in the eastern U.S. In: Communicating & advancing ecology: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 20. Abstract.

Iverson, Louis R.; Prasad, Anantha, M.; Hale, Betsy J.; Sutherland, Elaine Kennedy. 1999. An atlas of current and potential future distributions of common trees of the eastern United States. Gen. Tech. Rep. NE-265. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 245.

McNulty, Steven G.; Moore, Jennifer A.; Iverson, Louis; Prasad, Anantha; Abt, Robert; Smith, Bryan. 2000. Application of linked regional scale growth, biogeography, and economic models for southeastern United States pine forests. World Resource Review. 12(2): 298-320.

Prasad, A.M.; Iverson, L.R. 2000. A climate change atlas for 80 forest tree species of the eastern United States [database]. Delaware, OH: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. online publication. Available at: http://www.fs.fed.us/database/east_tree_atlas.html.

Sutherland, Elaine Kennedy.; Hale, Betsy J.; Hix, David M. 2000. Defining species guilds in the central hardwood forest, USA. Plant Ecology. 147: 1-19.

Yaussy, Daniel A. 2000. Comparison of an empirical forest growth and yield simulator and a forest gap simulator using actual 30-year growth from two even-aged forests in Kentucky. Forest Ecology and Management. 126: 385-398.

Yaussy, Daniel A.; Roush, Eric L. 2000. Partnership for healthier forests: the Raccoon Ecological Management Area (REMA). Ohio Woodland Journal. Spring: 16-21.

Cooperative

Hansen, A.J.; Dale, V.; Neilson, R.; Iverson, L.; Currie, D.; Shafer, S.; Bartlein, P. 2000. Biodiversity, climate, and land use: current knowledge and future prospects. In: Communicating & advance ecology: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 17. Abstract.

NORTHEAST RESEARCH STATION
Research Unit NE-4153

Cooperative

McKenney-Easterling, Mary; DeWalle, David R.; Iverson, Louis R.; Prasad, Anantha; Buda, Anthony R. 2000. The potential impacts of climate change and variability on forests and forestry in the Mid-Atlantic Region. Climate Research. 14: 195-206.

Scott, Charles T.; Tyrrell, Lucy E.; Smith, Marie-Louise; Funk, David T. 1999. A monitoring system for research natural areas in the northeastern and midwestern United States. In: Aguirre-Bravo, Celedonio; Franco, Carlos Rodriguez, comps., eds. North American science symposium: toward a unified framework for inventorying and monitoring forest ecosystem resources; 1998 November 2-6; Guadalajara, Mexico. Proceedings RMRS-P-12. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 315-318.

Extramural

Rubino, D.C.; McCarthy, B.C. 2000. Dendrochronological analysis of white oak (Quercus alba L.) growing across a topographic moisture gradient in southern Ohio. In: Communicating & advancing technology: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 190. Abstract.

Attainment

The publication of GTR-NE-265, Atlas of Current and Potential Future Distributions of Common Trees of the Eastern United States, has resulted in high praise from the public. The impact of publication has resulted in newspaper, radio, and television interviews for the authors and requests to present this work to the WO, as a keynote address to the International Association for Landscape Ecology, and a symposium for the Ecological Society of America.

Research on improving predictive vegetative mapping is continuing with new statistical software using multivariate adaptive regression splines.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4153

Problem 2 Ecosystem management practices must be developed to meet demand for sustainability while providing timber products

Publications

Research

Boerner, Ralph E.J.; Decker, Kelly L.M.; Sutherland, Elaine Kennedy. 2000. Prescribed burning effects on soil enzyme activity in a southern Ohio hardwood forest: a landscape-scale analysis. Soil Biology & Biochemistry. 32: 899-908.

Boerner, Ralph E.J.; Morris, Sherri Jeakins; Sutherland, Elaine Kennedy; Hutchinson, Todd F. 2000. Spatial variability in soil nitrogen dynamics after prescribed burning in Ohio mixed-oak forests. Landscape Ecology. 15: 425-439.

Hutchinson, T.F.; Sutherland, S.; Sutherland, E. Kennedy. 2000. Prescribed fire and understory vegetation dynamics in Ohio Quercus forests. In: Communicating & advancing technology: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 291. Abstract.

Iverson, Louis; Yaussy, Daniel. 2000. Atlas of current and potential future distributions of common trees of the eastern United States. Ohio Hetuch. 24(1): 12.

Cooperative

Sutherland, E. Kennedy; Smith, K.T. 2000. Wound characteristics in common central hardwood trees after prescribed burning. In: Communicating & advancing technology: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 132. Abstract.

Extramural

Artman, V.L.; Downhower, J.F. 2000. Prescribed burning to restore mixed-oak communities in southern Ohio: effects on breeding bird populations. In: Communicating & advancing ecology: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 46. Abstract.

Dress, W.J.; Boerner, R.E.J. 2000. Root decomposition and nutrient budgets in roots from an oak-hickory forest in southern Ohio: influence of landscape position and fire regime. In: Communicating & advancing technology: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 88. Abstract.

Attainment

Research on the effectiveness of prescribed burning to restore oak ecosystems continued in the areas entomology, soil and root ecology, and forest floor plant communities. Members of the project helped organize, and presented research results of this study at a workshop on Fire, People, and the Central Hardwood Landscape.

NORTHEASTERN RESEARCH STATION
Research Station NE-4153

Attainment

The project was awarded a $1,000,000 five-year grant as part of a national study to investigate the effects of prescribed burning and intermediate cuttings on forest ecosystems. This research will expand the previous work performed by this project on the prescribed burning to restore oak ecosystems. Cooperators in the study include scientists from NE-4558, Ohio State University, and Ohio University. The three replications of the study are being installed on Mead Paper Co. lands and two Ohio Dept. Of Natural Resources State Forests.

Problem 3 Integrated methods of monitoring forest ecosystems are needed for sustainability and scientific understanding

Publications

Research

DeHayes, Donald H.; Jacobson, George L., Jr.; Schaberg, Paul G.; Bongarten, Bruce; Iverson, Louis; Dieffenbacher-Krall, Ann C. 2000. Forest responses to changing climate: lessons from the past and uncertainty for the future. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 495-540.

Fortin, M.C.J.; Olson, R.J.; Ferson, S.; Iverson, L.; Hunsaker, C.; Edwards, G. 2000. Issues related to the detection of boundaries. Landscape Ecology. 15: 453-466.

Kohl, Michael; Scott, Charles T. 2000. A comparison of periodic versus permanent surveys. In: Hansen, Mark; Burk, Tom, eds. Proceedings of the IUFRO conference, integrated tools for natural resources inventories in the 21st century; 1998 August 16-20; Boise, ID. Gen. Tech. Rep. NC-212: U.S. Department of Agriculture, Forest Service, North Central Research Station: 94-103.

Scott, Charles T. 2000. Estimating two-way tables based on forest surveys. In: Hansen, Mark; Burk, Tom, eds. Proceedings of the IUFRO conference, integrated tools for natural resources inventories in the 21st century; 1998 August 16-20; Boise, ID. Gen. Tech. Rep. NC-212. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station: 234-238.

Scott, Charles T.; Klopfer, Scott D. 1999. Standard forest sampling designs and their analysis using TabGen. In: Aguirre-Brown, Celedonio; Franco, Carlos Rodriguez, comps. North American science symposium: toward a unified framework for inventorying and monitoring forest ecosystem resources; 1998 November 1-6; Guadalajara, Jaisco, Mexico. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 87-89.

Extramural

Dettmers, Randy; Bart, Jonathan. 1999. A GIS modeling method applied to predicting forest songbird habitat. Ecological Applications. 9(1): 152-163.

Robison, Scott A.; McCarthy, Brian C. 1999. Potential factors affecting the estimation of light availability using hemispherical photography in oak forest understories. Journal of the Torrey Botanical Society. 126(4): 344-349.

Attainment

Technology transfer of research results are continuing in the areas of monitoring Research Natural Areas, analyzing forest sampling designs, and comparisons of periodic and permanent forest surveys.

Data was collected and analyzed on the characteristics of wounds caused by prescribed fire as related to tree species and size.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4155

Ecology and Management of Northern Forest Ecosystems
Brissette, John C, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Understanding both ecologic and economic impacts of forest ecosystem manipulation	448	3.3	12	2	1
2. Understanding relationships between composition and structure of forests and the needs of wildlife	394	1.5	5	1	0
3. Understanding how natural and anthropogenic disturbances affect ecological processes	346	2	10	3	0

NORTHEASTERN RESEARCH STATION
Research Unit NE-4155

Problem 1 Understanding both ecologic and economic impacts of forest ecosystem manipulation

Publications

Research

Brissette, John C. 2000. Comparing natural regeneration under uneven-aged and even-aged silviculture in a mixed northern conifer ecosystem. In: Emmingham, William H., ed. Proceedings of the IUFRO interdisciplinary uneven-aged management symposium; 1997 September 15-19; Corvallis, OR. Corvallis, OR, Oregon State University: 338. Abstract.

Brissette, John C.; Frank, R.M., Jr.; Stone, Timothy L.; Skratt, Thomas A. 1999. Precommercial thinning in a northern conifer stand: 18-year results. The Forestry Chronicle. 75(6): 967-972.

Brissette, John C.; Frank, Robert M. 1999. Precommercial thinning in mixed northern conifers: results of a study at the Penobscot Experimental Forest. In: Wagner, R.G.; Egan, A.F.; Ostrofsky, W.D.; Seymour, R.S., comps. Conference proceedings: thinning in the Maine forest; 1999 November 15-16; Augusta, ME. Orono, ME: University of Maine, Cooperative Forestry Research Unit: 87-93.

Brissette, John C.; Kenefic, Laura S. 2000. Eastern hemlock response to even- and uneven-aged management in the Acadian forest: results from the Penobscot Experimental Forest long-term silviculture study. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 23-28.

Hawley, Gary J.; DeHayes, Donald H.; Brissette, John C. 2000. Changes in the genetic diversity of eastern hemlock as a result of different forest management practices. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 122. Abstract.

Howard, Theodore; Sendak, Paul E.; Codrescu, Claudia. 2000. Eastern hemlock: a market perspective. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 161-166.

Kenefic, L.S.; Seymour, R.S. 2000. Patterns of tree growth and structural development of uneven-aged northern conifer stands in the Acadian forest of Maine. In: Emmingham, William H., comp. Proceedings of the IUFRO interdisciplinary uneven-aged management symposium; 1997 September 5-19; Corvallis, OR. Corvallis, OR: Oregon State University: 554-568.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4155

Research

Kenefic, Laura S.; Seymour, Robert S. 2000. Growth patterns of Tsuga canadensis in managed uneven-aged northern conifer stands. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 29-33.

Leak, W.B. 1999. Species composition and structure of a northern hardwood stand after 61 years of group/patch selection. Northern Journal of Applied Forestry. 16(3): 151-153.

Leak, William B. 1999. Short versus long rotations. Northern Journal of Applied Forestry. 16(4): 200-202.

McClure, Jan W.; Lee, Thomas D.; Leak, William B. 2000. Gap capture in northern hardwoods: patterns of establishment and height growth in four species. Forest Ecology and Management. 127: 181-189.

Sendak, Paul E.; Leak, William B.; Rice, Wanda B. 2000. Hardwood tree quality development in the White Mountains of New Hampshire. Northern Journal of Applied Forestry. 17(1): 9-15.

Cooperative

Baumgras, John E.; Sendak, Paul E.; Sonderman, David L. 2000. Ring shake in eastern hemlock: frequency and relationship to tree attributes. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 156-160.

Hallett, R.A.; Bailely [Bailey], S.W.; Horsley, S.B.; Long, R.P. 1999. Sugar maple nutrition and health in the northeastern United States. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Rustad, L.E.; Marion, G.M.; Norby, R.J.; Mitchell, M.J.; Hartley, A.E.; Cornelissen, H.; Gurevitch, J.; Campbell, J.; GCTE-News. 1999. A meta-analysis of ecosystem response to experimental warming. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Solomon, Dale S.; Leak, William B. 2000. Application of silvicultural systems in northern New England forests. In: Proceedings of the Society of American Foresters 1999 national convention; 1999 September 11-15; Portland, OR. SAF Publ. 001. Bethesda, MA: Society of American Foresters: 255-261.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4155

Cooperative

Solomon, Dale S.; Leak, William B. 1999. Growth and stocking of eastern hemlock (Tsuga canadensis) in New England. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 43-49.

Extramural

Bell, F. Wayne; Ter-Mikaelian, Michael T.; Wagner, Robert G. 2000. Relative competitiveness of nine early-successional boreal forest species associated with planted jack pine and black spruce seedlings. Canadian Journal of Forest Research. 30: 790-800.

Wagner, R.G.; Egan, A.F.; Ostrofsky, W.D.; Seymour, R.S. 1999. Conference proceedings: thinning in the Maine forest. 1999 November 15-16; Augusta, ME. Orono, ME: University of Maine, Cooperative Forestry Research Unit. 116.

Attainment

Work under Problem 1 focuses on long-term research on regeneration, stand dynamics, and productivity in northern forests. Much of the field effort is on the Bartlett Experimental Forest (BEF) and Penobscot Experimental Forest (PEF). At BEF, 48-year remeasurement of a single-tree selection compartment to determine changes in species, structure, and tree grade was completed. A study plan was written for a commercial thinning study, which is a followup to a precommercial thinning study initiated about 1960. The long-term forest management study on the PEF now has at least 40 years of inventory data representing 9 major treatments and a control. These data are being analyzed and will provided the basis for comparing stand dynamics and productivity, and financial returns. Uneven-aged stands in this study are being used to investigate growth dynamics and leaf area relationships. Updating the PEF database to make it PC-compatible was completed. A system of permanent plots and an inventory of overstory and understory plants was completed at the Massabesic Experimental Forest.

Project scientists and staff participated in numerous field tours and workshops, including: sessions in Vermont on hardwood tree investment evaluation, two regeneration workshops in New Hampshire, a conference on thinning in Maine forests, a Nature Conservancy workshop on ecologically compatible silviculture, loggers training, hardwood silviculture for Plum Creek Timber Company, review of Sustainable Forestry Initiative standards for Mead Corporation, participation on regional subcommittees on commercial thinning and hardwood silviculture research, and a session on cross-border research cooperation between New Brunswick and Maine.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4155

Problem 2 Understanding relationships between composition and structure of forests and the needs of wildlife

Publications

Research

Costello, Christine A.; Yamasaki, Mariko; Pekins, Pete J.; Leak, William B.; Neefus, Chris D. 2000. Songbird response to group selection harvests and clearcuts in a New Hampshire northern hardwood forest. Forest Ecology and Management. 127: 41-54.

Kenefic, Laura S.; Nyland, Ralph D. 2000. Habitat diversity in uneven-aged northern hardwood stands: a case study. Res. Pap. NE-714. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 4.

Yamasaki, Mariko; DeGraaf, Richard M.; Lanier, John W. 2000. Wildlife habitat associations in eastern hemlock - birds, smaller mammals and forest carnivores. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 135-143.

Yamasaki, Mariko; McLellan, Toni M.; DeGraaf, Richard M.; Costello, Christine A. 2000. Effects of land-use and management practices on the presence of brown-headed cowbirds in the White Mountains of New Hampshire and Maine. In: Smith, James N.M.; Cook, Terry L.; Rothstein, Stephen I.; Robinson, Scott K.; Sealy, Spencer G., comps., eds. Ecology and management of cowbirds and their hosts. Austin, TX: University of Texas Press: 311-319.

Yamasaki, Mariko; Stevens, Rachel. 2000. Relative activity of forest bats related to opening size in the Bartlett Experimental Forest, New Hampshire--a preliminary examination. In: 80th annual meeting American Society of Mammalogists; 2000 June 17-21; Durham, NH. Durham, NH: University of New Hampshire: 15. Abstract.

Cooperative

DeGraaf, Richard M.; Yamasaki, Mariko. 1999. Bird and mammal habitat in riparian areas. In: Verry, Elon S.; Hornbeck, James W.; Dolloff, C. Andrew, comps., eds. Riparian management in forests of the continental eastern United States. Washington, DC: Lewis Publishers: 139-156.

Extramural

Barr, Garrett Evan. 2000. Effects of biotic and abiotic factors on larval plethodontid salamanders. University of New Hampshire: M.S. Thesis. 10.

Attainment

Work under Problem 2 focuses on describing associations between forest-dwelling wildlife and forest structure. In fiscal year 2000, areas that were included: sampling breeding birds and small mammals in a size-of-opening study at the Bartlett Experimental Forest (BEF); measuring the effects of ice storm disturbance and forest management practices on terrestrial salamander habitat and occurrence, also at the BEF and in cooperation with the University of New Hampshire; sampling forest bats using ultrasonic detection and mist-nets in the size-of-opening study on the BEF, also in cooperation with the University of New Hampshire, a study on stream salamander and fish competition in various watershed in the White Mountains.

Project scientists and staff led numerous wildlife habitat field tours for university students, natural resource professionals, non-governmental organizations and advocacy groups, and as part of logger education workshops. A project scientist serves on state agency technical advisory groups for bats, mammals, birds, and herps; and on a national Sustainable Forestry Initiative review of Champion International operations in northern New England.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4155

Problem 3 Understanding how natural and anthropogenic disturbances affect ecological processes

Publications

Research

Funk, David. 1999. Review of "Evolution or the garden of earthly delights." Natural Areas Journal. 19(4): 412-413.

Hallett, R.A.; Hornbeck, J.W. 2000. Managing oak and pine stands on outwash sands: protecting plant nutrients. Northern Journal of Applied Forestry. 17(2): 57-61.

Hallett, Richard A.; Bailey, Scott W.; Martin, Mary E.; Campbell, John L. 1999. The MAPBGC project: landscape scale tools for assessing susceptibility to calcium depletion. In: AGU 1999 fall meeting; 1999 November 16-19; San Francisco, CA. AGU 80(46): H32-04 1330h. Poster.

Hallett, Richard A.; Bailey, Scott W.; Martin, Mary E.; Campbell, John. L. 1999. The MAPBGC project: landscape scale tools for assessing susceptibility to calcium depletion. AGU 80(46): F390. Abstract.

Hendericks, Joseph J.; Aber, John D.; Nadelhoffer, Knute J.; Hallett, Richard A. 2000. Nitrogen controls on fine root substrate quality in temperate forest ecosystems. Ecosystems. 3: 57-69.

Kenefic, Laura S.; Seymour, Robert S. 1999. Leaf area prediction models for Tsuga canadensis in Maine. Canadian Journal of Forest Research. 29: 1574-1582.

Martin, M.E.; Smith, M.L.; Ollinger, S.V.; Hallett, R.A.; Goodale, C.L.; Aber, J.D. 1999. Applying AVIRIS at the sub-regional scale: forest productivity and nitrogen and cation cycling. In: Green, Robert L., comp. ed. Summaries of the 8th FPL airborne earth science workshop; 1999 December; Pasadena, CA. Pasadena, CA: Jet Propulsion Laboratory. Available at: http://makalu.jpl.nasa.gov/docs/workshops/toc.htm.

Martin, Mary E.; Smith, Marie-Louise. 1999. The MAPBGC project: hyperspectral remote sensing of foliar chemistry in an area of complex terrain. In: AGU 1999 fall meeting; 1999 November 16-19; San Francisco, CA. AGU 80(46): H32B-02 1330h. Poster.

Smith, Marie L. 2000. Landscape-scale prediction of forest productivity by hyperspectral remote sensing of canopy nitrogen. University of New Hampshire: Ph.D. Dissertation. 70.

Smith, Marie-Louise; Ollinger, Scott V. 1999. The MAPBGC project: remote detection of foliar chemistry as a means of predicting nitrogen mineralization and forest productivity. In: AGU 1999 fall meeting; 1999 November 16-19; San Francisco, CA. AGU 80(46): H32B-03 1330h. Poster.

Cooperative

Bailey, S.W.; Horsley, S.B.; Long, R.P.; Hallett, R.A. 1999. Influence of edaphic Ollinger, Scott V.; Aber, John D.; Bailey, Scott W.; Goodale, Christine L.; Hallett, Richard A.; Martin, Mary E.; Smith, Marie-Louise. 1999. The MAPBGC project: remote sensing, mapping and analysis of forest productivity and biogeochemical cycles in the White Mountains, NH. In: AGU 1999 fall meeting; 1999 November 16-19; San Francisco, CA. AGU 80(46): H32B-01 1330h. Poster.

Ollinger, Scott V.; Aber, John D.; Bailey, Scott W.; Goodale, Christine L.; Hallett, Richard A.; Martin, Mary E.; Smith, Marie-Louise. 1999. The MAPBGC project: remote sensing, mapping, and analysis of forest productivity and biogeochemical cycles in the White Mountains, NH. AGU 80(46): F390. Abstract.

Scott, Charles T.; Tyrrell, Lucy E.; Smith, Marie-Louise; Funk, David T. 1999. A monitoring system for research natural areas in the northeastern and midwestern United States. In: Aguirre-Bravo, Celedonio; Franco, Carlos Rodriguez, comps., eds. North American science symposium: toward a unified framework for inventorying and monitoring forest ecosystem resources; 1998 November 2-6; Guadalajara, Mexico. Proceedings RMRS-P-12. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 315-318.

Extramural

Anderson, Mark G. 2000. Viability and spatial assessment of ecological communities in the northern Appalachian ecoregion. University of New Hampshire: Ph.D. Dissertation. 224.

Ollinger, Scott V. 2000. Carbon and nitrogen dynamics of northeastern U.S. forests in response to environmental stress: measurements and models at local regional scales. University of New Hampshire: Ph.D. Dissertation. 125.

Selva, Steven B.; Tibell, Leif. 1999. Lichenized and non-lichenized calicioid fungi from North America. The Bryologist. 102(3): 377-397.

Attainment

Much of the work under Problem 3 is within the MAPBGC project (Mapping and Analysis of forest Productivity and BioGeochemical Cycling) in cooperation with the University of New Hampshire. The first cycle of stream water samples were collected and will be correlated with foliar chemistry for several watersheds in the White Mountain National Forest. The goal is to predict stream water quality from foliar chemistry maps derived from remote sensing imagery. Further funding has been received from EPA to complete an assessment of the Neversink River Basin in the Catskill Mountains. The goal is to assess the ability of remote sensing technology to determine where nitrogen saturation has occurred. The MAPBGC project relies heavily on state-of-the-art technology, primarily a hyperspectral sensor mounted on a high altitude aircraft platform. Recently, funding was secured from NASA to test the capabilities of the first space-based hyperspectral sensor to be launched in late 2000.

Attainment

Another major thrust in this problem area is the study of sugar maple health across the region. The on-going effort to collect and analyze soil, foliage, health and tree core data from approximately 90 sugar maple plots region wide is progressing. In an effort to use remote sensing technology to better understand forest health, project personnel have coauthored two proposals focusing on using hyperspectral remote sensing technology to map and detect hemlock wooly adelgid (HWA) infestation. The proposed work also involves gaining an understanding of soil nutrient status and the effects on HWA infestation rate and subsequent hemlock decline.

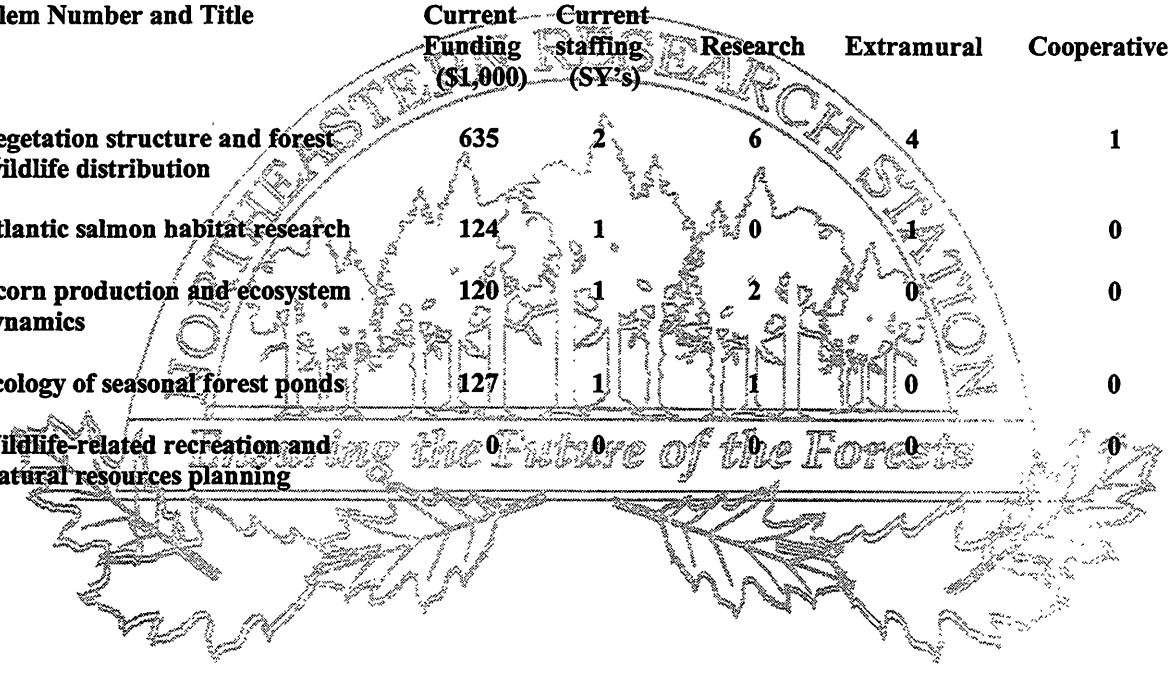
Results from both major thrusts of this problem have been presented at a number of scientific meetings.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4251

Wildlife and Fish Habitat Relationships and Recreation Opportunities in New England Forests
DeGraaf, Richard M, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Vegetation structure and forest wildlife distribution	635	2	6	4	1
2. Atlantic salmon habitat research	124	1	0	1	0
3. Acorn production and ecosystem dynamics	120	1	2	0	0
4. Ecology of seasonal forest ponds	127	1	1	0	0
5. Wildlife-related recreation and natural resources planning	0	0	0	0	0



NORTHEASTERN RESEARCH STATION
Research Unit 4251

Problem 1 Vegetation structure and forest wildlife distribution

Publications

Research

King, David I. 1999. Mortality of an adult Veery incurred during the defense of nestlings. Wilson Bulletin. 111(4): 576-577.

King, David I.; Champlin, Tracey B.; Champlin, Paul J. 2000. An observation of cooperative breeding in the ovenbird. Wilson Bulletin. 112(2): 287-288.

King, David I.; DeGraaf, Richard M. 2000. Bird species diversity and nesting success in mature, clearcut and shelterwood forest in northern New Hampshire, USA. Forest Ecology and Management. 129: 227-235.

King, David I.; Griffin, Curtice R.; Champlin, Paul J.; Champlin, Tracey B. 2000. An evaluation of the use of The Nature Conservancy vegetation classification for mapping bird distribution at Chincoteague National Wildlife Refuge. Natural Areas Journal. 20(1): 78-84.

King, David I.; Rappole, John H. 2000. Winter flocking of insectivorous birds in montane pine-oak forests in Middle America. The Condor. 102: 664-672.

Maier, Thomas J.; DeGraaf, Richard M. 2000. Predation on Japanese quail vs. house sparrow eggs in artificial nests: small eggs reveal small predators. The Condor. 102(2): 325-332.

Yamasaki, Mariko; DeGraaf, Richard M.; Lanier, John W. 2000. Wildlife habitat associations in eastern hemlock - birds, smaller mammals and forest carnivores. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 135-143.

Yamasaki, Mariko; McLellan, Toni M.; DeGraaf, Richard M.; Costello, Christine A. 2000. Effects of land-use and management practices on the presence of brown-headed cowbirds in the White Mountains of New Hampshire and Maine. In: Smith, James N.M.; Cook, Terry L.; Rothstein, Stephen I.; Robinson, Scott K.; Sealy, Spencer G., comps., eds. Ecology and management of cowbirds and their hosts. Austin, TX: University of Texas Press: 311-319.

Cooperative

DeGraaf, Richard M.; Yamasaki, Mariko. 1999. Bird and mammal habitat in riparian areas. In: Verry, Elon S.; Hornbeck, James W.; Dolloff, C. Andrew, comps., eds. Riparian management in forests of the continental eastern United States. Washington, DC: Lewis Publishers: 139-156.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4251

Extramural

Kluza, Daniel A.; Griffin, Curtice R.; DeGraaf, Richard M. 2000. Housing developments in rural New England: effects on forest birds. Animal Conservation. 3(1): 15-26.

Rappole, John H.; King, David I.; Barrow, Wylie C., Jr. 1999. Winter ecology of the endangered Golden-cheeked Warbler. The Condor. 101: 762-770.

Rappole, John H.; King, David I.; Leimgruber, Peter. 2000. Winter habitat and distribution of the endangered Golden-cheeked Warbler (Dendroica chrysoparia). Animal Conservation. 2: 45-49.

Stokes, Austin E.; Schultz, Brian B.; DeGraaf, Richard M.; Griffin, Curtice R. 2000. Setting mist nests from platforms in the forest canopy. Journal of Field Ornithology. 71(1): 57-65.

Attainment

Bird species distribution and predation rates on natural and artificial nests were compared among unmanaged mature, shelterwood, and clearcut northern hardwoods forest to evaluate their effects on bird populations. Twenty-three of 48 bird species detected differed in abundance among unmanaged mature forest, shelterwoods, and clearcuts. Analyses of bird abundance and habitat structure suggest that differences in bird species distribution were the result of differences in habitat structure. Bird species diversity and species richness were higher in shelterwoods than either mature forest or clearcuts, although there were bird species that occurred exclusively, or nearly so, in each treatment. Predation rates on artificial nests were lowest in mature forest, and predation rates on natural nests was highest in mature forest, although neither difference was statistically significant. We conclude that use of partial cutting exclusively would result in the decline of several species of mature forest and clearcut specialists, and, consequently, a decrease in species diversity at the landscape scale. The use of a variety of silvicultural techniques is recommended to maintain bird species diversity in forested landscapes.

Nest predation studies frequently use eggs such as Japanese Quail to identify potential predators of Neotropical migrants' eggs, but such eggs may be too large or thick-shelled to identify all potential predators. We compared predation events and predators of Japanese Quail and smaller House Sparrow eggs in paired, camera-monitored ground nests within edges and interiors of 40 mixed-hardwood forest stands. House Sparrow eggs were depredated more than Japanese Quail eggs at both forest edges and interiors. Eleven potential predator species disturbed nests, six of which were confirmed as predators. Use of House Sparrow eggs revealed predation by eastern chipmunks and Black-capped Chickadee, but not by white-footed mice, the most abundant small mammal species in all 40 stands. Neither predator species composition (as detected by camera) nor the frequency of nest predation differed between forest edge and interior. We conclude that the egg type used in artificial nest studies affects both predation rates and the predators detected.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4251

Problem 2 Atlantic salmon habitat research

Publications

Extramural

Juanes, Francis; Letcher, Ben H.; Gries, Gabriel. 2000. Ecology of stream fish: insights gained from an individual-based approach to juvenile Atlantic salmon. Ecology of Freshwater Fish. 9: 65-73.

Attainment

Spatial and temporal variation in growth conditions for young juveniles may determine the ultimate success of salmonid populations. To assess this aspect of habitat quality, a spatially-explicit bioenergetics model was developed to predict age-0 Atlantic salmon (Salmo salar) growth rate potential (GRP) in rearing streams of the Connecticut River, from the time of stocking in the spring, to the end of the summer. During the first month after stocking, there appears to be a paucity of suitable habitat. Most available habitat is predicted to result in low foraging success of small fish and to be energetically stressful due to the combination of high spring discharge and low water temperature. Although less than 14% of available habitat was predicted to support positive growth in the spring, 47% of the fish we observed occupied microhabitats predicted to yield positive growth, indicating the importance of habitat selection. In contrast, from mid-June to August, 67% of available habitat was predicted to yield positive growth, and 92% of all fish occupied positive growth microhabitats. Consistent with these results, sites with higher salmon GRP in the early season, but not in the mid or late season, had higher final salmon densities by the end of August. Hydroclimatic regimes characteristic of more southerly rearing streams in the Connecticut River basin were predicted from our model to cause a potential shift from early season to late season habitat-related growth constraints along this environmental gradient. This work demonstrates the value of applying a bioenergetics approach to issues related to conservation of Atlantic salmon, and provides a framework for future research on early-life history energetic determinants of habitat quality.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4251

Problem 3 Acorn production and ecosystem dynamics

Publications

Research

Brooks, Robert T. 1999. Residual effects of thinning and high white-tailed deer densities on northern redback salamanders in southern New England oak forests. Journal of Wildlife Management. 63(4): 1172-1180.

Healy, William M.; Powell, Shawn M. 2000. Wild turkey harvest management: biology, strategies, and techniques. Biological Technical Publication, BTP-R5001-1999. Washington, DC: United States Fish and Wildlife Service: 96.

Attainment

The regrowth of eastern forests and subsequent increase in acorn production are factors in the successful introduction of the wild turkey, after turkey populations reached their low point throughout the U.S. in the 1930's, and serious restoration efforts began in the 1950s. By 1975, restoration was well under way in the Northeast. Turkey populations are now completely restored to their original range and beyond, and it became clear that standardized methods and protocols for data gathering were needed for sound management. Despite the success of the restoration and the popularity of turkey hunting, increasing turkey populations and improving habitat conditions cannot go on indefinitely. Habitat conditions are likely to stabilize and decline as mature timber is harvested, development continues, and northeastern dairy farms and pastures disappear. When turkey populations respond to these landscape changes, harvesting programs will be questioned. This report explains the biological basis for hunting, the mechanisms for regulating harvest, and the effect of harvest on populations.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4251

Problem 4 Ecology of seasonal forest ponds

Publications

Research

Brooks, Robert T.; Lust, Noel, eds. 2000. The science of managing forests to sustain water resources. Water, Air, and Soil Pollution. 122(1-2): 1.

Attainment

Water levels in a sample of 24 ephemeral (vernal) forest ponds were monitored bi-weekly to determine hydroperiod patterns during a season of greater than average precipitation. Basin surveys to determine depth-related pond volume and area were conducted for the 10 ponds not surveyed in 1999. Preliminary analysis of the 1998-99 benthic macroinvertebrate surveys were begun.

A large number of new ponds were visited for consideration for inclusion in a new study of the effectiveness of Massachusett's forestry Best Management Practices for vernal ponds. A subset of ponds that met size and shape criteria and had undisturbed catchments were selected for basin surveys and hydroperiod monitoring. A list of 23 candidate ponds were identified for consideration for inclusion in the study.

Precipitation amount and chemistry were measured weekly at a centrally-located NADP site.

Problem 5 Wildlife-related recreation and natural resources planning

Attainment

No progress to report this period.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4352

Ecological Processes: A Basis for Managing Forests and Protecting Water Quality in New England
Eagar, Christopher, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. How do the cumulative effects of disturbance and atmospheric deposition affect biogeochemistry of nutrient base cations, forest health, and ecosystem function in northern hardwood forests?	412	1.5	3	0	1
2. What is the range of mineral weathering contributions to nutrient capital in northeastern forests?	193	.8	0	0	3
3. What processes and conditions control the extent to which forest and aquatic ecosystems respond to nitrogen deposition?	262	1.1	2	0	1
4. What are dynamics of community structure, biomass accumulation, and nutrient uptake of northeastern forest ecosystems: how are they effected by disturbances?	54	.2	2	0	0
5. Synthesize knowledge and long-term data bases to develop guidelines for natural resource managers to protect stream quality, etc.	50	.3	2	0	6
M1. Hubbard Brook Experimental Forest will be maintained: for forest ecosystem research; as Biosphere Reserve	275	.6	1	4	0

NORTHEASTERN RESEARCH STATION
Research Unit NE-4352

Problem 1 How do the cumulative effects of disturbance and atmospheric deposition affect biogeochemistry of nutrient base cations, forest health, and ecosystem function in northern hardwood forests?

Publications

Research

Arnold, S.S.; Fernandez, I.J.; Rustad, L.E.; Zibilske, L.M. 1999. Microbial response of an acid forest soil to experimental soil warming. Biology and Fertility of Soils. 30: 239-244.

Bailey, Scott W. 2000. Geologic and edaphic factors influencing susceptibility of forest soils to environmental change. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 27-49.

Hallett, R.A.; Hornbeck, J.W. 2000. Managing oak and pine stands on outwash sands: protecting plant nutrients. Northern Journal of Applied Forestry. 17(2): 57-61.

Hornbeck, James W.; Bailey, Scott W. 1999. Cation depletion in the northeastern United States and its effects on forest health. In: Proceedings of the 1999 NCASI northeastern regional meeting: Vol. II; 1999 October 26-28; Portland, ME. [Place of publication unknown]: [Publisher name unknown]: Abstract.

Cooperative

Bailey, S.W.; Horsley, S.B.; Long, R.P.; Hallett, R.A. 1999. Influence of edaphic and geologic factors on the health of sugar maple on the Allegheny Plateau. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 302. Abstract.

Hallett, R.A.; Bailely [Bailey], S.W.; Horsley, S.B.; Long, R.P. 1999. Sugar maple nutrition and health in the northeastern United States. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Long, R.P.; Horsley, S.B.; Bailey, S.W.; Lilja, P.R. 1999. Base cation additions increase growth and vigor of overstory sugar maple. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Attainment

Base cations are leached or removed from forested ecosystems in northeastern United States primarily by processes associated with atmospheric deposition and forest harvesting. Recent studies suggest that rock weathering rates and dry deposition can not keep pace with lost nutrients, resulting in depletion of base cation capitals and a potential threat to forest health. Studies of nutrient cycles in the 3 major forest types in the Northeast show that projected losses of nutrients due to atmospheric deposition are greater than those associated with forest harvesting, and that certain forest types and sites are more susceptible to depletion than others. The depletion of base cations, especially calcium, has several implications. In addition to being an essential nutrient for tree growth, calcium is an important buffer in soil and water. Loss of calcium by leaching can mean a lower pH of soil and soil solution, and mobilization of inorganic aluminum to the extent that aluminum can interfere with the uptake of calcium at the soil-root interface. The role of base cation depletion in forest productivity and health may be specific to certain species and sensitive sites.

Recent dieback of sugar maple on the Allegheny Plateau has been linked to severe insect defoliation with poor base-cation nutrition as an essential predisposing factor. Foliar analyses across a broader portion of the Northeast suggest that many currently healthy stands may be at risk. Current research focuses on defining threshold levels of nutrient requirements and developing spatial models, which predict site sensitivity.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4352

Problem 2 What is the range of mineral weathering contributions to nutrient capital in northeastern forests?

Publications

Research

Hallett, Richard A.; Bailey, Scott W.; Martin, Mary E.; Campbell, John L. 1999. The MAPBGC project: landscape scale tools for assessing susceptibility to calcium depletion. In: AGU 1999 fall meeting; 1999 November 16-19; San Francisco, CA. AGU 80(46): H32-04 1330h. Poster.

Hallett, Richard A.; Bailey, Scott W.; Martin, Mary E.; Campbell, John. L. 1999. The MAPBGC project: landscape scale tools for assessing susceptibility to calcium depletion. AGU 80(46): F390. Abstract.

Cooperative

Hislop, J.E.; Hornbeck, J.W.; Bailey, S.W.; Hallett, R.A. 1999. Continued development and testing of forest soil reference samples and digestion methods. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT: [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Ollinger, Scott V.; Aber, John D.; Bailey, Scott W.; Goodale, Christine L.; Hallett, Richard A.; Martin, Mary E.; Smith, Marie-Louise. 1999. The MAPBGC project: remote sensing, mapping and analysis of forest productivity and biogeochemical cycles in the White Mountains, NH. In: AGU 1999 fall meeting; 1999 November 16-19; San Francisco, CA. AGU 80(46): H32B-01 1330h. Poster.

Ollinger, Scott V.; Aber, John D.; Bailey, Scott W.; Goodale, Christine L.; Hallett, Richard A.; Martin, Mary E.; Smith, Marie-Louise. 1999. The MAPBGC project: remote sensing, mapping, and analysis of forest productivity and biogeochemical cycles in the White Mountains, NH. AGU 80(46): F390. Abstract.

Attainment

Nutrient cycling studies of forested watersheds in northern New England demonstrate a great range in nutrient loss and sensitivity to depletion of available nutrient pools. Calcium loss due to acid rain, farming and harvesting is of concern to forest managers in the White Mountain National Forest (WMNF). Due to structural and lithologic complexity of bedrock in this region, as well as the incorporation of transported materials in glacial deposits, spatial patterns in soil mineral or chemical content are not always apparent. New tools are necessary to assess cation supply for tree growth at a landscape scale. Two landscape scale models are being developed that can be used to identify areas in the WMNF that are susceptible to calcium depletion. The first model predicts calcium content in soil parent material using a simple GIS-based model which uses bedrock geology, lithologic composition and direction of glacial transport to predict spatial variation of calcium content in soil parent material for glacial till landscapes. The second provides an estimate of foliar calcium in the forest canopy created form remote sensing imagery collected by an Airborne Visible/InfraRed Imaging Spectrometer (AVIRIS), a hyperspectral sensor with high spectral resolution.

Problem 3 What processes and conditions control the extent to which forest and aquatic ecosystems respond to nitrogen deposition?

Publications

Research

Campbell, John L.; Hornbeck, James W.; McDowell, William H.; Buso, Donald C.; Shanley, James B.; Likens, Gene E. 2000. Dissolved organic nitrogen budgets for upland, forested ecosystems in New England. Biogeochemistry. 49: 123-142.

Rustad, Lindsey E.; Melillo, Jerry M.; Mitchell, Myron J.; Fernandez, Ivan J.; Steudler, Paul A.; McHale, Patrick J. 2000. Effects of soil warming on carbon and nitrogen cycling. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 357-381.

Cooperative

Evans, J.L.; Fernandez, I.J.; Rustad, L.E. 1999. The response of soil C and N to forest ecosystem change. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 296. Abstract.

Attainment

Relatively high deposition of nitrogen (N) in the northeastern United States has caused concern because sites could become N saturated. In the past, mass-balance studies have been used to monitor the N status of sites and to investigate the impact of increased N deposition. Typically, these efforts have focused on dissolved inorganic forms of N (DIN = NH4-N + NO3-N) and have largely ignored dissolved organic nitrogen (DON) due to difficulties in its analysis. Recent advances in the measurement of total dissolved nitrogen (TDN) have facilitated measurement of DON as the residual of TDN - DIN. We calculated DON and DIN budgets using data on precipitation and streamwater chemistry collected from 9 forested watersheds at 4 sites in New England. TDN in precipitation was composed primarily of DIN. Net retention of TDN ranged from 62 to 89% (4.7 to 10 kg ha-1 yr-1) of annual inputs. DON made up the majority of TDN in stream exports, suggesting that inclusion of DON is critical to assessing N dynamics even in areas with large anthropogenic inputs of DIN. Despite the dominance of DON in streamwater, precipitation inputs of DON were approximately equal to outputs. Streamwater NO3-N was the only fraction of N that exhibited a seasonal pattern, with concentrations increasing during the winter months and peaking during snowmelt runoff. Concentrations of NO3-N varied considerably among watersheds and are related to DOC:DON ratios in streamwater. Annual DIN exports were negatively correlated with streamwater DOC:DON ratios, indicating that these ratios might be a useful index of N status of upland forests.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4352

Problem 4 What are dynamics of community structure, biomass accumulation, and nutrient uptake of northeastern forest ecosystems: how are they effected by disturbances?

Publications

Research

Martin, C.W.; Bailey, A.S. 1999. Twenty years of change in a northern hardwood forest. Forest Ecology and Management. 123: 253-260.

Miller-Weeks, Margaret; Eagar, Chris. 1999. The northeastern ice storm 1998: a forest damage assessment for New York, Vermont, New Hampshire, and Maine. Concord, NH: North East Foresters Association (NEFA) and Newtown Square, PA: U.S. Department of Agriculture, Forest Service, State and Private Forestry. 32 p.

Attainment

Forests undisturbed by logging play a vital role in our understanding and management of forest ecosystems. The Bowl Research Natural Area (RNA) in the White Mountains of New Hampshire is such a forest. The Bowl RNA and an adjacent area known to have been logged in 1888 were inventoried in 1974 and 1994. The mean basal area of the mixed forest below an elevation of 915 m in the RNA increased from 29 m2 ha-1 in 1974 to 32 m2 ha-1 in 1994. There was no significant difference in basal areas of the RNA forest and adjacent forest cut in 1888, in either the 1974 or 1994 sampling. Beech was the most numerous species in all areas of the Bowl followed by spruce-fir. Yellow birch had the greatest basal area followed by spruce-fir and beech. Results from this study indicate that northern hardwood forests of several hundred hectares can be expected to maintain average basal areas of ca. 30 m2 ha-1 and above-ground biomass of 150-250 Mg ha-1. Comparisons of the Bowl and nearby Hubbard Brook Experimental Forest indicate that, within 100 years following heavy forest cutting, the northern hardwood forest can be expected to regrow to the point where numbers of stems, basal area, and biomass will be comparable with old-growth forests.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4352

Problem 5 Synthesize knowledge and long-term data bases to develop guidelines for natural resource managers to protect stream quality, etc.

Publications

Research

Rustad, Lindsey E. 1999. Network of ecosystem warming studies. GCTE News, 14: 2-3.

Rustad, Lindsey E.; Huntington, Thomas G.; Boone, Richard D. 2000. Controls on soil respiration: implications for climate change. Biogeochemistry. 48: 1-6.

Cooperative

Hornbeck, James W.; Kochenderfer, James N. 2000. Linkages between forests and streams: a perspective in time. In: Verry, Elon S.; Hornbeck, James W.; Dolloff, C. Andrew, comps., eds. Riparian management in forests of the continental eastern United States. Boca Raton, FL: CRC Press LLC: 89-98.

Megahan, Walter F.; Hornbeck, Jim W. 2000. Lessons learned in watershed management: a retrospective view. In: Ffolliott, Peter F.; Baker, Malchus B., Jr., Edminster, Carleton, B.; Dillon, Madelyn C.; Mora, Karen L. tech. coords; 2000 March 13-16; Tucson, AZ. RMRS-P-13. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 177-188.

Rustad, L.E.; Marion, G.M.; Norby, R.J.; Mitchell, M.J.; Hartley, A.E.; Cornelissen, H.; Gurevitch, J.; Campbell, J.; GCTE-News. 1999. A meta-analysis of ecosystem response to experimental warming. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Verry, Elon S.; Hornbeck, James W.; Dolloff, C. Andrew. 2000. Riparian management in forests of the continental eastern United States. Boca Raton, FL: CRC Press LLC: 402.

Verry, Elon S.; Hornbeck, James W.; Todd, Albert H. 2000. Watershed research and management in the Lake States and northeastern United States. In: Ffolliott, Peter F.; Baker, Malchus B., Jr.; Edminster, Carleton B.; Dillon, Madelyn, C.; Mora, Karen L.; tech coords. Proceedings, land stewardship in the 21st century: the contributions of watershed management; 2000 March 13-16; Tucson, AZ. RMRS-P-13. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 81-92.

Welsch, Dave J.; Hornbeck, James W.; Verry, Elon S.; Dolloff, C. Andrew; Greis, John G. 2000. Riparian area management: themes and recommendations. In: Verry, Elon S.; Hornbeck, James W.; Dolloff, C. Andrew, comps., eds. Riparian management in forests of the continental eastern United States. Boca Raton, FL: CRC Press LLC: 321-340.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4352

Attainment

Riparian areas in forests of the Eastern United States provide a variety of products and amenities, among the more important being protection of water quality and aquatic habitats. Management of riparian areas has moved to the forefront because of conflicts between their protection capabilities and the ever-increasing use they receive. Each day, thousands of natural resource managers face the challenge of managing eastern riparian areas characterized by fragmented ownership, fragmented ecosystems, and diverse interest groups. We produced a book, "Riparian Management in Forests of the Continental Eastern U.S.", that summarizes the state-of-the art in managing forested riparian areas. Forty-nine authors from universities; county, state, and federal agencies; forest industries; and natural resource endeavors contributed to this book and provided a broad perspective on the unique needs of riparian forest management in the Continental Eastern United States. The mixtures of people and land uses found in the east require the manager to adapt their knowledge to each location. Management in the east will always need to deal with professional managers from many disciplines, with multidisciplinary teams, and with stake holder groups that differ from watershed to watershed. This book does not provide a single answer to apply everywhere, but provides a set of tools and a set of values preferred by diverse authors. The resource manager and those who advise them can adapt this knowledge and their experiences to our diverse conditions and complex social dimensions. We realize that land management in the east is bound to these realities, and we have built this book to help us manage in a responsible way. This book will be of use to natural resource administrators, educators, and on-the-ground managers from industry, consulting firms, and municipal, state, and federal agencies who routinely face the complex problems of caring for, protecting and teaching about riparian areas.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4352

Problem M1 Hubbard Brook Experimental Forest will be maintained: for forest ecosystem research; as Biosphere Reserve

Publications

Research

Martin, C. Wayne; Likens, Gene E.; Buso, Donald C. 2000. Comparison of long-term precipitation chemistry measurements at the Hubbard Brook Experimental Forest, New Hampshire. Water, Air, and Soil Pollution. 120: 359-379.

Extramural

Groffman, P.M. 1999. Carbon additions increase nitrogen availability in northern hardwood forest soils. Biology and Fertility in Soils. 29: 430-433.

Groffman, Peter M.; Hardy, Janet P.; Nolan, Scott; Fitzhugh, Ross D.; Driscoll, Charles T.; Fahey, Timothy J. 1999. Snow depth, soil frost and nutrient loss in a northern hardwood forest. Hydrological Processes. 13: 2275-2286.

Johnson, Chris E.; Driscoll, Charles T.; Siccama, Thomas G.; Likens, Gene E. 2000. Element fluxes and landscape position in a northern hardwood forest watershed ecosystem. Ecosystems. 3: 159-184.

Sillett, T. Scott; Holmes, Richard T.; Sherry, Thomas W. 2000. Impacts of a global climate cycle on population dynamics of a migratory songbird. Science. 288: 2040-2042.

Attainment

Chemical changes along headwater streams at the Hubbard Brook Experimental Forest in New Hampshire suggest that important differences exist in biogeochemical cycles along an altitudinal gradient within small watershed ecosystems. Using data collected during the period 1982-92, we have constructed elemental budgets [Ca, Mg, K, Na, Si, Al, dissolved organic carbon (DOC), S, and N] for three subcatchments within watershed 6, a forested watershed last logged around 1917-20. The biogeochemistry of the high-elevation spruce-fir-white birch subcatchment was dominated by processes involving naturally occurring organic compounds. The middle-elevation subcatchment, dominated by hardwood vegetation, had the greatest net production of inorganic-monomeric aluminum (Ali), and exhibited net immobilization of DOC and Alo. The low-elevation subcatchment, also characterized by deciduous vegetation, had the highest rates of net production of base cations (Ca2+, Mg2+, K+, Na+) among the subcatchments. We observed up to 15-fold differences in the net production of Ca, Mg, K, Na, and Si in soils of the three subcatchments within this 13.2-ha watershed. The dissolution of feldspar in the hardwood subcatchments could account for only 26%-37% of the observed net Ca output. The loss of Ca from soil exchange sites and organic matter is the most likely source of the unexplained net export. Our results illustrate the sensitivity of watershed-level studies to spatial scale. However, it appears that much of the variation in element fluxes occurs in the first 10-20 ha of drainage area.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4353

Sustainable Forest Ecosystems in the Central Appalachians
Adams, Mary Beth, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Information is needed on historical disturbance patterns and influences on ecosystem processes	105	.3	1	1	0
2. Quantitative information is needed about important ecosystem processes and impacts of disturbances	663	1.9	4	9	2
3. Efficient and ecologically sound silvicultural alternatives must be developed to meet complex management objectives and provide for sustainable production and availability of many forest benefits	594	1.7	4	1	0
4. Develop guidelines for a variety of management and operation practices and develop tools to monitor, evaluate and mitigate impacts on soil productivity, water quality and quantity	385	1.1	0	0	2

NORTHEASTERN RESEARCH STATION
Research Unit NE-4353

Problem 1 **Information is needed on historical disturbance patterns and influences on ecosystem processes**

Publications

Research

Schuler, Thomas M.; Gillespie, Andrew R. 2000. Temporal patterns of woody species diversity in a central Appalachian forest from 1856 to 1997. Journal of the Torrey Botanical Society. 127(2): 149-161.

Extramural

Adams, Harold S.; Stephenson, Steven L.; Adams, Mary Beth; Lawrence, David M. 1999. Ecological status of mid-appalachian red spruce communities. In: Eckerlin, Ralph P., ed. Proceedings of the Appalachian biogeography symposium; 1999 June 25-29; Blacksburg, VA. Spec. Publ. 7. Blacksburg, VA: Virginia Museum of Natural History: 235. Abstract.

Attainment

Long-term temporal patterns of species diversity in a Central Appalachian mixed forest were documented, and analyzed with respect to time and different disturbance regimes. Diversity has declined, partly due to an increase in the importance of sugar maple (Acer saccharum). The increasing dominance of this species suggests new silvicultural practices are needed to maintain diversity of Central Appalachian forests.

Research in red spruce/northern hardwood ecotones in West Virginia and Virginia suggests that red spruce basal area and density are increasing. If these trends persist, then red spruce may regain some of its previous importance in forests of the Central Appalachians.

NORTHEASTERN RESEARCH
Research Unit NE-4353

Problem 2 Quantitative information is needed about important ecosystem processes and impacts of disturbances

Publications

Research

Adams, M.B.; Edwards, P.J.; Kochenderfer, J.N.; Wood, F. 1999. Effects of ten years of elevated N and S additions on watershed processes: the Fernow whole watershed acidification study. In: NADP technical committee meeting proceedings; 1999 October 25-28. Sacramento, CA. [Place of publication unknown]: National Atmospheric Deposition Program: 57. Abstract.

Crews, Jerry T.; Wright, Linton. 2000. Temperature and soil moisture regimes in and adjacent to the Fernow Experimental Forest. Res. Pap. NE-713. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 4.

Edwards, Pamela.; Tranel, Michael; Brease, Philip; Sousanes, Pamela. 2000. Stream and river water quality in Danali National Park and Preserve, Alaska. In: Kane, Douglas L. , ed. Water resources in extreme environments: proceedings of the AWRA spring specialty conference; 2000 May 1-3; Anchorage, AK. Middleburg, VA: American Water Resources Association: 203-207.

Edwards, Pamela.; Willard, Karl; Duffield, Daniel; Edgerton, Barry. 2000. Spawning gravel fine sediment levels between seasons and land type associations. In: Wigington, Parker J., Jr.; Beschta, Robert L.; eds. Riparian ecology and management in multi-land use watersheds: proceedings of the AWRA summer specialty conference; 2000 August 28-31; Portland, OR. Middleburg, VA: American Water Resources Association: 203-208.

Cooperative

Fernandez, Ivan J.; Adams, Mary Beth. 2000. Nitrogen saturation in experimental forested watersheds. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. New York, NY: Springer-Verlag: 333-355.

Hornbeck, James W.; Kochenderfer, James N. 2000. Linkages between forests and streams: a perspective in time. In: Verry, Elon S.; Hornbeck, James W.; Dolloff, C. Andrew, comps., eds. Riparian management in forests of the continental eastern United States. Boca Raton, FL: CRC Press LLC: 89-98.

McCay, Timothy S.; Komoroski, Mark J.; Ford, William M. 1999. Use of an upland pine forest by the star-nosed mole, Condylura cristata. Journal of the Elisha Mitchell Scientific Society. 115(4): 316-318.

Extramural

Carter, Timothy C.; Carroll, Steven K.; Owen, Sheldon F.; Menzel, M. Alex; Ford, W. Mark; Feldhamer, George A.; Chapman, Brian R. 2000. Food habitats of the northern long-eared myotis (Myotis Septentrionalis) across space and time. In: 5th annual meeting of the southeastern Bat Diversity Network and 10th annual colloquium on conservation of mammals in the southeastern United States; 2000 February 23-26; Guntersville, AL. Auburn, AL: Auburn University. Abstract.

Carter, Timothy; Carroll, Steven; Owen, Sheldon; Menzel, Alex; Ford, Mark; Feldhamer, George; Chapman, Brian. 2000. Food habits of the northern long-eared myotis (Myotis septentrionalis) across space and time. In: 80th annual meeting of the American Society of Mammalogists; 2000 June 17-21; Durham, NH. Lawrence, KS: American Society of Mammalogists. Poster Abstract.

Castleberry, Nikole L.; Ford, W. Mark; Castleberry, Steven B.; Wood, Petra B. 2000. Food habits of the Allegheny woodrat in West Virginia and Virginia. In: 5th annual meeting of the southeastern Bat Diversity Network and 10th annual colloquium on conservation of mammals in the southeastern United States; 2000 February 23-26; Guntersville, AL. Auburn, AL: Auburn University. Abstract.

Castleberry, S.B.; King, T.L.; Wood, P.B.; Ford, W.M. 2000. Microsatellite DNA markers for the study of Allegheny woodrat (Neotomma magister) populations and cross-species amplification in the genus Neotoma. Molecular Ecology. 9: 824-826.

Castleberry, Steven B.; Wood, Petra B.; Ford, W. Mark; Mengar, Michael T.; Castleberry Nikole L. 2000. Effect of timber harvesting on habitat use of Allegheny woodrats. In: 5th annual meeting of the Southeastern Bat Diversity Network and tenth annual colloquium on conservation of mammals in the southeastern United States; 2000 February 23-26; Guntersville, AL. Auburn, AL: Auburn University. Abstract.

Laerm, Joshua; Ford, William Mark; McCay, Timothy S.; Menzel, Michael A.; Lepardo, Lisa T.; Boone, James L. 1999. Soricid communities in the southern Appalachians. In: Eckerlin, Ralph, P., ed. Proceedings of the Appalachian biogeography symposium; 1999 June 25-29; Blacksburg, VA. Blacksburg, VA: Virginia Museum of Natural History: 177-193.

Menzel, M. Alex; Carter, Tim C.; Owen, Sheldon F.; Menzel, Jennifer M.; Churchill, John B.; Edwards, John W. 2000. A review of homerange characteristics and habitat use patterns of eight species of vespertilionio bats from the eastern United States. In: 5th annual meeting of the southeastern Bat Diversity Network and 10th annual colloquium on conservation of mammals in the southeastern United States; 2000 February 23-26; Guntersville, AL. Auburn, AL: Auburn University. Abstract.

Menzel, M. Alex; Mensel, Jennifer M.; McCracken, Gary F.; Edwards, John W.; Kilgo, John C.; Ford, W. Mark. 2000. Time expansion bat detectors: the new millennium is upon us. In: 5th annual meeting of the southeastern Bat Diversity Network and 10th annual colloquium on conservation of mammals in the southeastern United States; 2000 February 23-26; Guntersville, AL. Auburn, AL: Auburn University. Abstract.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4353

Extramural

Owen, Sheldon F.; Menzel, Michael A.; Ford, W. Mark; Chapman, Brian R.; Miller, Karl V.; Edwards, John. 2000. The effects of harvesting intensity and stand structure on bat foraging and spatial activity patterns in the Allegheny Plateau physiographic province of West Virginia. In: 5th annual meeting of the southeastern Bat Diversity Network and 10th annual colloquium on conservation of mammals in the southeastern United States; 2000 February 23-26, Guntersville, AL. Auburn, AL: Auburn University. Abstract.

Attainment

A great deal of information about under-studied wildlife communities and their role in forest ecosystems was obtained this year. Bat use of forested landscape, foraging behavior, and food preferences were documented. Research on Allegheny woodrat, a "sensitive" species, revealed use of a variety of forest habitats, including those receiving diameter-limit and clearcut harvesting treatments. Research was begun to evaluate genetic diversity in Allegheny woodrat populations. New information on shrew communities in the Southern Appalachians was developed.

Research continues on the Fernow Whole Watershed Acidification Study. Timing of stream chemistry response was found to differ between baseflow and peakflow. The results of the Fernow study were compared with results from Bear Brooks Watershed in Maine, and mechanisms of N saturation explored. The linkages between forests and streams were explored and spawning gravel fine sediment levels linked with landtype associations.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4353

Problem 3 Efficient and ecologically sound silvicultural alternatives must be developed to meet complex management objectives and provide for sustainable production and availability of many forest benefits

Publications

Research

Carter, Timothy C.; Menzel, Michael A.; Ford W. Mark. 2000. Fire and bats in the East: something you've never thought about but probably should. In: The Wildlife Society 7th annual conference; 2000 September 12-16; Nashville, TN. Nashville, TN; The Wildlife Society: 75-76. Abstract.

Ford, W. Mark; Odom, Richard H.; Hale, Philip E.; Chapman, Brian R. 2000. Stand-age, stand characteristics, and landform effects on understory herbaceous communities in southern Appalachian cove-hardwoods. Biological Conservation. 93: 237-246.

Laerm, Joshua; Ford, W. Mark, Chapman, Brian R. 2000. Conservation status of terrestrial mammals of the southeastern United States. Chapman, Brian R.; Laerm, Joshua, eds. 4th colloquium on conservation of mammals in the southeastern United States. Occas. Pap. North Carolina Mus. Nat. Sci. and North Carolina Biol. Surv. No. 12. Raleigh, NC: North Carolina Museum of Natural Sciences: 4-16.

Laerm, Joshua; Ford, William Mark; Menzel, Michael, Alex; McCay, Timothy S. 2000. Analysis of distribution and habitat associations of Sorex hoyi winnemana in the southern Appalachians. In: Chapman, Brian R.; Laerm, Joshua, eds. 4th colloquium on conservation of mammals in the southeastern United States. Occas. Pap. North Carolina Mus. Nat. Sci. and North Carolina Biol. Surv. No. 12. Raleigh, NC: North Carolina Museum of Natural Sciences: 17-26.

Extramural

Castleberry, Steven B.; Ford, W. Mark.; Miller, Karl V.; Smith, Winston P. 2000. Influences of herbivory and canopy opening size on forest regeneration in a southern bottomland hardwood forest. Forest Ecology & Management. 131: 57-64.

Attainment

The interaction of white-tailed deer browsing and canopy opening size on relative abundance and diversity of woody and herbaceous vegetation was quantified. Species richness, diversity, evenness, and relative abundance varied among gap sizes at relatively low browsing pressure. In another study, herbaceous communities were studied in cove hardwood stands of different ages. Species richness, diversity and evenness did not vary with stand age, but were related to landscape variables and stand characteristics.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4353

Problem 4 **Develop guidelines for a variety of management and operations practices and develop tools to monitor, evaluate and mitigate impacts on soil productivity, water quality and quantity**

Cooperative

Odom, Richard H., Jr.; Ford, W. Mark. 2000. Predicting occurrence of the endangered Virginia northern flying squirrel using digital terrain data and landsat imagery. In: Geospatial information in agriculture and forestry: proceedings of the 2nd international conference, vol. 1; 2000 January 10-12; Lake Buena Vista, FL. [Place of publication unknown]: [Publisher name unknown]. Poster Abstract

Stuart, Gordon W.; Edwards, Pamela J.; McLaughlin, Keith R.; Phillips, Michael J. 1999. Monitoring the effects of riparian management on water resources. In: Verry, Elon S.; Hornbeck, James W.; Dolloff, C. Andrew, comp., ed. Riparian management in forests of the continental Eastern United States. Boca Raton, FL: CRC Press LLC: 287-302.

Attainment

The development of monitoring guidelines for riparian area management was described, and detailed steps for conducting monitoring activities provided.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4454

Integrating Social and Biophysical Sciences for Natural Resource Management
Twery, Mark J, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Social structures and processes: Resource managers need an improved understanding of the relationships among social institutions and organizations, forest management, and forest ecosystem processes to achieve their policy and management goals	240	2	3	0	0
2. Values and decision making: Natural resource managers need a better understanding of key human values that affect natural resource decisions and better tools for analyzing and evaluating alternative policies and management actions, particularly those...	303	2	9	1	0
3. Management applications: Natural resource managers face critical information gaps about an array of human social values regarding timber management, recreation, special forest products and biodiversity and the interactions of these values with management	171	1.2	5	0	0
4. Tool development: There is a need for decision support tools that integrate the best knowledge available about biophysical and social systems and assist managers and policy makers in using this knowledge to make decisions.	387	1	4	0	3

NORTHEASTERN RESEARCH STATION
Research Unit NE-4454

Problem 1 Social structures and processes: Resource managers need an improved understanding of the relationships among social institutions and organizations, forest management, and forest ecosystem processes to achieve their policy and management goals

Publications

Research

Emery, Marla. 1999. Social values of specialty forest products to rural communities. In: Josiah, Scott J., ed. Proceedings of the North American conference on enterprise development through agroforestry; 1998 October 4-7; Minneapolis, MN. St. Paul, MN: University of Minnesota: 25-32.

Grove, J.; Pickett, S.T.A.; Burch, W.R.,Jr. 2000. The Baltimore long term ecosystem study: a patch dynamics approach to the study of urban ecosystems. In: Communicating and advancing ecology: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 17.

Pickett, S.T.A.; Burch, William R.,Jr.; Grove, J. Morgan. 1999. Interdisciplinary research: maintaining the constructive impulse in a culture of criticism. Ecosystems. 2: 302-307.

Attainment

We have developed strong theoretical works on the relationships of social institutions and processes to the ecosystem within which they operate, from central urban environments to remote rural areas. Additional publications on the relationships of communities to their ecological surroundings demonstrate the basis for the theoretical work. We have documented the attitudes of nonindustrial private forest landowners toward ecosystem management and identified the effects that these attitudes may have on implementation of landscape or regional management goals.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4454

Problem 2 Values and decision making: Natural resource managers need a better understanding of key human values that affect natural resource decisions and better tools for analyzing and evaluating alternative policies and management actions, particularly those...

Publications

Research

Averill, James R.; More, Thomas A. 2000. Happiness. In: Lewis, Michael; Haviland-Jones, Jeannette M., comps., eds. Handbook of Emotions, 2nd ed. New York, NY: The Guilford Press: 663-676.

Dennis, Donald F. 2000. An ordered probit analysis of public values for use in multiple objective decision-making. Computers and Electronics in Agriculture. 27(1-3): 127-137.

Dennis, Donald F.; Stevens, T.H.; Kittredge, David B. 2000. Aspects of nonindustrial forest ownership that influence attaining recreation and other nontimber objectives. In: Kyle, Gerard, comp., ed. Proceedings of the 1999 northeastern recreation research symposium; 1999 April 11-14; Bolton Landing, NY. Gen. Tech. Rep. NE-269. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 215-218.

Kittredge, David B. Jr.; Stevens, Thomas. H.; Dennis, Donald. 2000. Cooperation among private forest landowners: how much and in what ways? In: Begus, Jurij; Anderson, Jon; Beck, Roland L., eds. IUFRO working party S6.06-03 extension: extension working party symposium: working under a dynamic framework-forest ownership structures and extension; 1999 October 4-8; Bled, Slovenia. S6-06.03. Ljubljana, Slovenia: Slovenia Forest Service: 82-93.

More, Thomas A. 1999. A functionalist approach to user fees. Journal of Leisure Research. 31(3): 227-244.

More, Thomas A. 2000. Reconceiving recreation policy in an era of growing social inequality. In: Kyle, Gerard, comp., ed. Proceedings of the 1999 northeastern recreation research symposium; 1999 April 11-14; Bolton Landing, NY. Gen. Tech. Rep. NE-269. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 415-419.

More, Thomas A.; Kuentzel, Walter F. 2000. Five reasons to have reservations about benefits-based management. In: Kyle, Gerard, comp., ed. Proceedings of the 1999 northeastern recreation research symposium; 1999 April 11-14; Bolton Landing, NY. Gen. Tech. Rep. 269. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 295-303.

More, Thomas. 2000. Terms of environment. Journal of Forestry (FOCUS). 98(7):12.

Stevens, T. H.; Belkner, R.; Dennis, D.; Kittredge, D.; Willis, C. 2000. Comparison of contingent valuation and conjoint analysis in ecosystem management. Ecological Economics. 32: 63-74.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4454

Extramural

Kyle, Gerard, comp., ed. 2000. Proceedings of the 1999 northeastern recreation research symposium. 1999 April 11-14; Bolton Landing, NY. Gen. Tech. Rep. NE-269. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 426.

Attainment

We continue to produce information on how publics value various resources from their public lands, and what tradeoffs they are willing to make. We have published extensively on user fees and their relationship to fair distribution of use of public lands. These publications have stimulated intense national discussions on the topic. We have demonstrated the importance of solitude as a value that people want from their forest lands. Additional work on the value of parks continues to provide managers with important information. Values desired from private lands through jointly developed ecosystem management goals and techniques have been derived from our current work.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4454

Problem 3 Management applications: Natural resource managers face critical information gaps about an array of human social values regarding timber management, recreation, special forest products and biodiversity and the interactions of these values with management

Publications

Research

Emery, Marla R. 2000. Forests and livelihood: political ecologies of U.S. and Third World non-timber forest products. In: Association of American Geographers 2000 annual meeting; 2000 April 4-8; Pittsburgh, PA. Washington, DC: Association of American Geographers. Abstract [on cd-rom].

Grimm, Nancy B.; Grove, J. Morgan; Pickett, Steward T.A.; Redman, Charles L. 2000. Integrated approaches to long-term studies of urban ecological systems. BioScience. 50(7): 571-584.

Huyler, Neil K. 2000. Cost of maple sap production for various size tubing operations. Res. Pap. NE-712. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 6.

Huyler, Neil K.; LeDoux, Chris B. 1999. Performance of a cut-to-length harvester in a single-tree and group-selection cut. Res. Pap. NE-711. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 6.

Nyland, Ralph D.; Ray, David G.; Yanai, Ruth D.; Briggs, Russell D.; Zhang, Lianjun; Cymbala, Robert J.; Twery, Mark J. 2000. Early cohort development following even-aged reproduction method cuttings in New York northern hardwoods. Canadian Journal of Forest Research. 30: 67-75.

Wade, G.L.; Twery, M.J.; Rechlin, M.; Story, M.J. 2000. Public education and forestry practices in the Northern Hardwood Forest. In: Communicating and advancing ecology: Ecological Society of America 85th annual meeting; 2000 August 6-10, Snowbird, UT. Washington, DC: Ecological Society of America: 351. Poster Abstract.

Attainment

We continue to develop and refine our understanding of how ecological relationships vary across scales from individual stands to landscape and regional levels. Restoration of ecosystem function on abandoned surface mines is an important problem for which we have provided needed information. Additional work on scale-dependent analysis of human-dominated ecosystems, such as Baltimore, MD, is producing new information on how human and "natural" ecosystems are actually an integrated whole. We have developed extensive information on how people use the forested environment to support their livelihoods in rural, poor communities. We are improving our knowledge of silvicultural treatments and their effects on the entire forest community, including understory vegetation and human recreationists.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4454

Problem 4 Tool development: There is a need for decision support tools that integrate the best knowledge available about biophysical and social systems and assist managers and policy makers in using this knowledge to make decisions.

Publications

Research

Hoffman, Robin E.; Twery, Mark J.; Alban, Laura M.; Nyland, Ralph D. 1999. Forests and people. NE-INF-138-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 20.

Potter, W.D.; Deng, X.; Li, J.; Xu, M.; Wei, Y.; Lappas, I.; Twery, M. J.; Bennett, D. J. 2000. A web-based expert system for gypsy moth risk assessment. Computers and Electronics in Agriculture. 27(1-3): 95-105.

Potter, W.D.; Bi, W.; Twardus, D.; Thistle, H.; Twery, M.J.; Ghent, J.; Teske, M. 2000. Aerial spray deposition management using the genetic algorithm. In: Loganantharaj, Rasiah; Palm, Gunther; Ali, Moonis, eds. Intelligent problem solving: methodologies and approaches: 13th international conference on industrial and engineering applications of artificial intelligence and expert systems; intelligent problem solving: methodologies and approaches; 2000 June 19-22; New Orleans, LA. Lecture Notes in Artificial Intelligence, 1821, Subseries of Lecture Notes in Computer Science. New York, NY: Springer: 210-219.

Twery, Mark J.; Rauscher, H. Michael; Bennett, Deborah J.; Thomasma, Scott A.; Stout, Susan L.; Palmer, James F.; Hoffman, Robin E.; DeCalesta, David S.; Gustafson, Eric; Cleveland, Helene; Grove, J. Morgan; Nute, Donald; Kim, Geneho; Kollasch, R. Peter. 2000. NED-1: integrated analyses for forest stewardship decisions. Computers and Electronics in Agriculture. 27(1-3): 167-193.

Cooperative

Nute, D.; Rosenberg, G.; Nath, S.; Verma, B.; Rauscher, H.M.; Twery, M.J.; Grove, M. 2000. Goals and goal orientation in decision support systems for ecosystem management. Computers and Electronics in Agriculture. 27(1-3): 355-375.

Rauscher, H. Michael; Lloyd, F. Thomas.; Loftis, David L.; Twery, Mark J. 2000. A practical decision-analysis process for forest ecosystem management. Computers and Electronics in Agriculture. 27(1-3): 195-226.

Rauscher, H. Michael; Plant, Richard E.; Thomson, Alan J.; Twery, Mark J. 2000. Foreward. Computer and Electronics in Agriculture. 27(1-3): 1-6.

Attainment

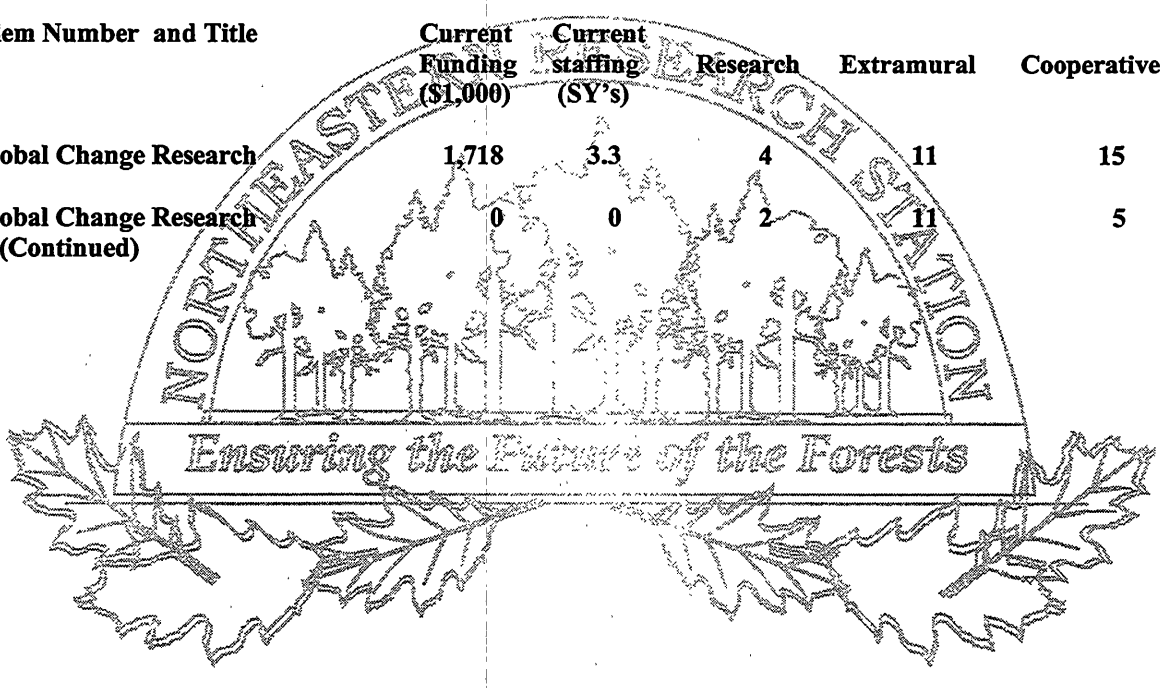
Progress this year includes distribution of hundreds of copies of software to promote better-informed decision making for ecosystem management. New software developed explores the methodology of analyzing multi-resource decisions and assists managers in balancing objectives. A better understanding of how goals for management can be constructed and how they may be interrelated has resulted from our work this year. Additional research into using a genetic algorithm to determine the best combination of spray equipment has produced information of great use to aerial applicators and resulted in an award winning publication.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4455

Global Change Research Program
Birdsey, Richard A, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Global Change Research	1,718	3.3	4	11	15
2. Global Change Research (Continued)	0	0	2	11	5



NORTHEASTERN RESEARCH STATION
Research Unit NE-4455

Problem 1 Global Change Research

Publications

Research

Arnold, S.S.; Fernandez, I.J.; Rustad, L.E.; Zibilske, L.M. 1999. Microbial response of an acid forest soil to experimental soil warming. Biology and Fertility of Soils. 30: 239-244.

Bailey, Scott W. 2000. Geologic and edaphic factors influencing susceptibility of forest soils to environmental change. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 27-49.

Chojnacky, D.C.; Jenkins, J.C. 2000. Allometric relationship between tree diameter and total aboveground biomass may be more species independent than previously thought. In: Ecological Society of America 85th annual meeting; 2000 August 6-9, Snowbird, UT. Washington. DC: Ecological Society of America: 73. Abstract.

DeHayes, Donald H.; Jacobson, George L., Jr.; Schaberg, Paul G.; Bongarten, Bruce; Iverson, Louis; Dieffenbacher-Krall, Ann C. 2000. Forest responses to changing climate: lessons from the past and uncertainty for the future. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 495-540.

Eav, Bov Bang; Birdsey, Richard A.; Heath, Linda S. 2000. The Kyoto Protocol and forestry practices in the United States. In: Krishnapillay, Baskaran; Soepadmo, E.; Arshad, Najib Lotfy: [and others], eds. XXI IUFRO World Congress: sub-plenary sessions; 2000 August 7-12; Kuala Lumpus, Malaysia. Kuala Lumpus, Malaysia: Malaysian XXI IUFRO World Congress Organizing Committee: 566-576.

Green, Edwin J.; MacFarlane, David W.; Valentine, Harry T. 2000. Bayesian synthesis for quantifying uncertainty in predictions from process models. Tree Physiology. 20(5/6): 415-419.

Heath, Linda S.; Smith, James E. 2000. An assessment of uncertainty in forest carbon budget projections. Environmental Science & Policy. 3: 73-82.

Heilman, Warren E.; Hom, John; Potter, Brian E. 2000. Climate and atmospheric deposition patterns and trends. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 51-116.

Heilman, Warren E.; Teclaw, Ronald M.; Eenigenburg, James E. 2000. Micrometeorological conditions at the forest-atmosphere carbon transfer and storage (FACTS-II) Aspen Face facility in northern Wisconsin. In: 11th symposium on global change studies; 2000 January 9-14; Long Beach, CA. Boston, MA: American Meteorological Society: 92-95.

Research

Hollinger, D.Y.; Goltz, S.M.; Davidson, E.A.; Lee, J.T.; Tu, K.; Valentine, H.T. 1999. Seasonal patterns and environmental control of carbon dioxide and water vapour exchange in an ecotonal boreal forest. Global Change Biology. 5(8): 891-902.

Hoover, Coeli M.; Birdsey, Richard A.; Heath, Linda S.; Stout, Susan L. 2000. How to estimate carbon sequestration on small forest tracts. Journal of Forestry. 98(9): 11-17.

Iverson, Louis; Yaussy, Daniel. 2000. Atlas of current and potential future distributions of common trees of the eastern United States. Ohio Hetuch. 24(1): 12.

Jenkins, Jennifer C.; Kicklighter, David W.; Aber, John D. 2000. Regional impacts of climate change and elevated carbon dioxide on forest productivity. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 383-424.

McWilliams, William H.; Heath, Linda S.; Reese, Gordon C.; Schmidt, Thomas L. 2000. Forest resources and conditions. In: Mickler, Robert A., Birdsey, Richard A.; Hom, John. comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 3-26.

Rustad, Lindsey E.; Huntington, Thomas G.; Boone, Richard D. 2000. Controls on soil respiration: implications for climate change. Biogeochemistry. 48: 1-6.

Rustad, Lindsey E.; Melillo, Jerry M.; Mitchell, Myron J.; Fernandez, Ivan J.; Steudler, Paul A.; McHale, Patrick J. 2000. Effects of soil warming on carbon and nitrogen cycling. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 357-381.

Schaberg, P.G.; DeHayes, D.H.; Hawley, G.J.; Strimbeck, G.R.; Cumming, J.R.; Murakami, P.E.; Borer, C.H. 2000. Acid mist and soil Ca and Al alter the mineral nutrition and physiology of red spruce. Tree Physiology. 20: 73-85.

Schaberg, P.G.; Snyder, M.C.; Shane, J.B.; Donnelly, J.R. 2000. Seasonal patterns of carbohydrate reserves in red spruce seedlings. Tree Physiology. 20: 549-555.

Schaberg, Paul G.; DeHayes, Donald H. 2000. Physiological and environmental causes of freezing injury in red spruce. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Response of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 181-227.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4455

Research

Shortle, Walter C.; Smith, Kevin T.; Minocha, Rakesh; Minocha, Subhash; Wargo, Philip M.; Vogt, Kristina A. 2000. Tree health and physiology in a changing environment. Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 229-274.

Sutherland, Elaine Kennedy.; Hale, Betsy J.; Hix, David M. 2000. Defining species guilds in the central hardwood forest, USA. Plant Ecology. 147: 1-19.

Valentine, Harry T.; Herman, David A.; Gove, Jeffrey H.; Hollinger, David Y.; Solomon, Dale S. 2000. Initializing a model stand for process-based projection. Tree Physiology. 20(5/6): 393-398.

Wargo, Philip M.; Auclair, Allan N.D. 2000. Forest declines in response to environmental change. In: Mickler, Robert A.; Birdsey, Richard A,; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 117-145.

Cooperative

Alexeyev, V.A.; Birdsey, R.A.; Stakanov, V.D.; Korotkov, L.A. 2000. Carbon storage in the Asian Boreal Forests of Russia. In: Kasischke, E.S.; Stocks, B.J., comps., eds. Fire, climate change, and carbon cycling in the boreal forests. New York, NY: Springer-Verlag: 239-257.

Birdsey, Richard A.; Mickler, Robert A.; Hom, John; Heath, Linda S. 2000. Summary of prospective global change impacts on northern U.S. forest ecosystems. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 543-568.

Daly, Christopher; Bachelet, Dominique; Lenihan, James M.; Neilson, P.; Parton, William; Ojima, Dennis. 2000. Dynamic simulation of tree-grass interactions for global change studies. Ecological Application. 10(2): 449-469.

Fernandez, Ivan J.; Adams, Mary Beth. 2000. Nitrogen saturation in experimental forested watersheds. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. New York, NY: Springer-Verlag: 333-355.

Goodale, C.L.; NCEAS Carbon Working Group. 2000. A common framework for the forest carbon budget of Eurasia and North America. In: The role of the boreal forests and forestry in the global carbon budget; 2000 May 8-12; Edmonton, AB. [Place of publication unknown]: [Publisher name unknown]: 14. Abstract.

NORTHEAST RESEARCH STATION
Research Unit NE-4455

Cooperative

Heilman, W.E.; Teclaw, R.M.; Isebrands, J.G.; Karnosky, D.F.; Hendrey, G.R.; Pregitzer, Kurt S. 2000. Impacts of elevated CO2 and O3 concentrations on forest microclimates: initial observations from the FACTS-II Aspen FACE facility. In: Air pollution, global change and forests in the new millennium: 19th international meeting for specialists in air pollution effects on forest ecosystems; 2000 May 28-31; Houghton, MI. Houghton, MI: Michigan Technological University: 36. Abstract.

Isebrands, J.G.; Host, G.E.; Lenz, K.; Wu, G.; Stech, H.W. 2000. Hierarchical, parallel computing strategies using component object model for process modelling responses of forest plantations to interacting multiple stresses. In: Ceulemans, R.J.M.; Veroustraete, F.; Gond, V., comps., eds. Forest ecosystem modelling, upscaling and remote sensing. The Hague, The Netherlands: SPB Academic Publishing: 123-135.

Isebrands, Judson G.; Dickson, Richard E.; Rebbeck, Joanne; Karnosky, David F. 2000. Interacting effects of multiple stresses on growth and physiological processes in northern forest trees. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 149-180.

Jenkins, Jennifer C.; Kicklighter, David W.; Ollinger, Scott V.; Aber, John D.; Melillo, Jerry M. 1999. Sources of variability in net primary production predictions at a regional scale; a comparison using PnET-II and TEM 4.0 in northeastern US forests. Ecosystems. 2: 555-570.

Karnosky, D.F.; Mankovska, B.; Percy, K.; Dickson, R.E.; Pokila, G.K.; Sober, J. 1999. Effects of tropospheric C3 on trembling aspen and interaction with CO2; results from an O3-gradient and FACE experiment. Water, Air, and Soil Pollution. 116: 311-322.

Mickler, Robert A.; Birdsey, Richard A.; Hom, John, eds. 2000. In: Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 578 p.

Murray, Brian G.; Prisley, Stephen P.; Birdsey, Richard A.; Sampson, R. Neil. 2000. Carbon sinks in the Kyoto protocol. Journal of Forestry. 98(9): 6-11.

Ollinger, Scott V.; Aber, John D.; Bailey, Scott W.; Goodale, Christine L.; Hallett, Richard A.; Martin, Mary E.; Smith, Marie-Louise. 1999. The MAPBGC project: remote sensing, mapping, and analysis of forest productivity and biogeochemical cycles in the White Mountains, NH. AGU 80(46): F390. Abstract.

Schlamadinger, Bernhard; Karjalainen, Timo; Birdsey, Richard A.; Cannell, M.; Galinski, W.; Gintings, A. 2000. Afforestation, reforestation, and deforestation (ARD) activities. In: Watson, R.T.; Noble, I.R.; Bolin, B. [and others], comps., eds. Land use, Land-use change, and forestry. Cambridge, UK: Cambridge University Press: 127-179.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4455

Cooperative

Williams, David W.; Liebhold, Andrew M. 2000. Spatial scale and the detection of density dependence in spruce budworm outbreaks in eastern North America. Oecologia. 124: 544-552.

Williams, David W.; Long, Robert P.; Wargo, Philip M.; Liebhold, Andrew M. 2000. Effects of climate change on forest insect and disease outbreaks. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 455-494.

Williams, David W.; McManus, Michael L. 1999. Anoplophora glabripennis, a recent invader from China into urban forests of the United States. In: Forster, B.; Knizek, M.; Grodzki, W., eds. Proceedings of the 2nd workshop of the IUFRO WP, methodology of forest insect and disease survey in central Europe; 1999 April 20-23; Sion-Chateauneuf, Switzerland. Birmensdorf, Switzerland: Swiss Federal Institute for Forest, Snow and Landscape Research: 252-253.

Yorks, Thad E.; Jenkins, Jennifer C.; Leopold, Donald J.; Raynal, Dudley J.; Orwig, David A. 2000. Influences of eastern hemlock mortality on nutrient cycling. In: Proceedings symposium on sustainable management of hemlock ecosystems in eastern North America. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 126-133.

Extramural

Curtis, Peter S.; Vogel, Christoph S.; Wang, Xianzhong; Pregitzer, Kurt S.; Zak, Donald R.; Lussenhop, John. 2000. Gas exchange, leaf nitrogen, and growth efficiency of Populus tremuloides in a CO2-enriched atmosphere. Ecological Applications. 10(1): 3-17.

King, John S.; Pregitzer, Kurt S.; Zak, Donald R. 1999. Clonal variation in above- and below-ground growth responses of Populus tremuloides Michaux: influence of soil warming and nutrient availability. Plant and Soil. 217: 119-130.

Kubiske, Mark E.; Pregitzer, Kurt S.; Zak, Donald R.; Mikan, Carl J. 1998. Growth and C allocation of Populus tremuloides genotypes in response to atmospheric CO2 and soil N availability. New Phytologist. 140: 251-260.

Laurence, John A.; Ollinger, Scott V.; Woodbury, Peter D. 2000. Regional impacts of ozone on forest productivity. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 425-454.

Lawrence, Gregory B.; Vogt, Kristina A.; Vogt, Daniel J.; Tilley, Joel P.; Wargo, Philip M.; Tyrrell, Margaret. 2000. Atmospheric deposition effects on surface waters, soils, and forest productivity. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 275-330.

Pregitzer, Kurt S.; King, John S.; Burton, Andrew J.; Brown, Shannon E. 2000. Responses of tree fine roots to temperature. New Phytol. 147: 105-115.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4455

Extramural

Rothstein, David E.; Zak, Donald R.; Pregitzer, Kurt S.; Curtis, Peter S. 2000. Kinetics of nitrogen uptake by Populus tremuloides in relation to atmospheric CO2 and soil nitrogen availability. Tree Physiology. 20: 265-270.

Schimel, David; Melillo, Jerry; Nan, Hanqin; McGuire, A. David; Kicklighter, David; Kittel, Timothy. 2000. Contribution of increasing CO2 and climate to carbon storage by ecosystems in the United States. Science. 287: 2004-2006.

Sievering, Herman. 1999. Nitrogen deposition and carbon sequestration. Nature. 400: 629-630.

Yin, X. 1999. Evaluation of solar irradiance models with a special reference to globally-parameterized and land cover-sensitive Solar 123. Theoretical and Applied Climatology. 64: 249-261.

Zak, Donald R.; Holmes, William E.; MacDonald, Neil W.; Pregitzer, Kurt S. 1999. Soil temperature, matric potential, and the kinetics of microbial respiration and nitrogen mineralization. Soil Science Society of America Journal. 63: 575-584.

Zak, Donald R.; Pregitzer, Kurt S. 1998. Integration of ecophysiological and biogeochemical approaches to ecosystem dynamics. In: Pace, Michael; Groffman, Peter, comps., eds. Successes, limitations, and frontiers in ecosystem science. New York, NY: Springer-Verlag: 372-403.

Attainment

The Program published a book by Springer-Verlag titled "Responses of Northern U.S. Forests to Environmental Change" that summarized the research results of the first decade of the Northern Global Change Research Program.

The Program provided support for two major U.S. programs of experimental research that directly addresses carbon cycle issues: the Ameriflux national network of CO2 flux towers that measure net ecosystem carbon exchange, and the Free Air Carbon Dioxide Exposure (FACE) facility in Rhinelander, WI. The FACE facility is the largest ecosystem-scale fumigation experiment in the world, emphasizing ecosystem-level responses to the multiple stress interactive effects of elevated CO2 and ozone on northern hardwood tree species. Numerous publications from this experiment are listed.

The Northern Global Change Research Program collaborates with a counterpart program in the South to integrate models and data bases for supporting regional and national assessments. Several publications were based on this activity.

The Program has continued to support research on the effects of acid deposition on forest ecosystems, with research results addressing the stress response and health of montane coniferous forest ecosystems to persistent acid-induced alteration of membrane-associated calcium.

Problem 2 Global Change Research (Continued)

Research

Carpenter, C.A.; Cooksey, R.; Heath, L.; Luther, T.; McLellan, T.; Peterson, F.; Raimo, D.; Schmidt, T.L.; Twardus, D. 2000. Criteria and indicator based assessment in the northeastern United States. In: Eckhoff, Janet D., ed. 2nd North American forest ecology workshop: forest ecology into the next millennium: putting the long view into practice; 1999 June 27-30; Orono, ME. Orono, ME: University of Maine: 76. Abstract.

Hallett, Richard A.; Bailey, Scott W.; Martin, Mary E.; Campbell, John L. 1999. The MAPBGC project: landscape scale tools for assessing susceptibility to calcium depletion. In: AGU 1999 fall meeting; 1999 November 16-19; San Francisco, CA. AGU 80(46): H32-04 1330h. Poster.

Heisler, Gordon, M.; Grant, Richard H. 2000. Ultraviolet radiation, human health, and the urban forest. Gen. Tech. Rep. NE-268. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 35.

Iverson, Louis R.; Prasad, Anantha, M.; Hale, Betsy J.; Sutherland, Elaine Kennedy. 1999. An atlas of current and potential future distributions of common trees of the eastern United States. Gen. Tech. Rep. NE-265. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 245.

Jenkins, J.C.; Birdsey, R.A. 1999. Validation databases for simulation models: biomass and net primary productivity (NPP) estimation using forest inventory data. In: Legacies, landscapes and limits: bridging borders: 84th annual meeting of the Ecological Society of America; 1999 August 8-12; Spokane, WA. Washington, DC: Ecological Society of America: 117. Abstract.

McNulty, Steven G.; Moore, Jennifer A.; Iverson, Louis; Prasad, Anantha; Abt, Robert; Smith, Bryan. 2000. Application of linked regional scale growth, biogeography, and economic models for southeastern United States pine forests. World Resource Review. 12(2): 298-320.

Perkins, T.D.; Adams, G.T.; Lawson, S.T.; Schaberg, P.G.; McNulty, S.G. 2000. Long-term nitrogen fertilization increases winter injury in montane red spruce (Picea rubens) foliage. Journal of Sustainable Forestry. 10(1/2): 165-172.

Potter, Brian F. 2000. Asymmetric diurnal-cycles in forests and the calculation of heat sums. In: 24th conference on agricultural and forest meteorology; 14th conference on biometeorology and aerobiology; 2000 August 14-18; Davis, CA. Boston, MA: American Meteorological Society: 36-37.

Schaberg, P.G.; Strimbeck, G.R.; Richard; Hawley, G.J.; DeHayes, D.H.; Shane, J.B.; Murakami, P.F.; Perkins, T.D.; Donnelly, J.R.; Wong, B.L. 2000. Cold tolerance and photosystem function in a montane red spruce population: physiological relationships with foliar carbohydrates. Journal of Sustainable Forestry. 10(1/2): 173-180.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4455

Publications

Research

Yaussy, Daniel A. 2000. Comparison of an empirical forest growth and yield simulator and a forest gap simulator using actual 30-year growth from two even-aged forests in Kentucky. Forest Ecology and Management. 126: 385-398.

Cooperative

Fast, Jerome D.; Heilman, Warren E. 2000. Simulations of ozone in the Great Lakes Region. In: 24th conference on agricultural and forest meteorology; 14th conference on biometeorology and aerobiology; 2000 August 14-18; Davis, CA. Boston, MA: American Meteorological Society: 176-177.

Fernandez, Ivan J.; Simmons, Jeffrey A.; Briggs, Russell D. 2000. Indices of forest floor nitrogen status along a climate gradient in Maine, USA. Forest Ecology and Management. 134: 177-187.

Isebrands, J.G.; Host, G.E.; McTavish, K.; Lenz, K.E. 1999. Modeling short-rotation forest plantations using hierarchial, parallel computing: a developmental history of ECOPHYS. In: Amaro, Ana; Tome, Margarida; eds. Empirical and process-based models for forest tree and stand growth simulation; 1997 September 21-27; Oeiras, Portugal. Lisbon, Portugal: Edicoes Salamandra: 537-551.

Jenkins, Jennifer C.; Canham, Charles D.; Barten, Paul K. 2000. Predicting long-term forest development following hemlock mortality. In: Proceedings symposium on sustainable management of hemlock ecosystems in eastern North America. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 62-75.

Karnosky, David F.; Percy, Kevin E.; Dickson, Richard E.; Isebrands, Judson G.; Podila, Gopi K. 2000. Genetic implications for forest trees of increasing levels of greenhouse gases and UV-B radiation. In: Matyas, D., comp., ed. Forest genetics and sustainability. Dortrecht, The Netherlands: Kluwer Academic Publishers: 111-124.

McKenney-Easterling, Mary; DeWalle, David R.; Iverson, Louis R.; Prasad, Anantha; Buda, Anthony R. 2000. The potential impacts of climate change and variability on forests and forestry in the Mid-Atlantic Region. Climate Research. 14: 195-206.

Phillips, Donald L.; Brown, Sandra L.; Schroeder, Paul E.; Birdsey, Richard A. 2000. Toward error analysis of large-scale forest carbon budgets. Global Ecology & Biogeography. 9: 305-313.

Extramural

Aber, John D.; Freuder, Rita. 2000. Variation among solar radiation data sets for the Eastern US and its effects on predictions of forest production and water yield. Climate Research. 15: 33-43.

Brown, Shannon E.; Pregitzer, Kurt S.; Reed, David D.; Burton, Andrew J. 2000. Predicting daily mean soil temperature from daily mean air temperature in four northern hardwood forest stands. Forest Science. 46(2): 297-301.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4455

Extramural

Goodale, C.L.; NCEAS Carbon Working Group. 2000. Carbon uptake in forests of Eurasia and North America. In 85th Annual Meeting of the Ecological Society of America. 2000 August 6-9; Snowbird, UT. Suppl. Bull. Ecol. Soc. Am. p 107. Abstract.

MacDonald, Neil W.; Witter, John A.; Reed, David D.; Burton, Andrew J.; Pregitzer, Kurt S.; Liechty, Hal O. 1998. Environmental stress effects on vigor, mortality, and growth in northern hardwood forests along a pollution-climate gradient. Michigan Academician. 30: 27-47.

Mladenoff, D.J.; Hong, S. He. 1999. Design, behavior and application of LANDIS, an object-oriented model of forest landscape disturbance and succession. In: Mladenoff, D.J.; Baker, W.L., comps., eds. Spatial modeling of forest landscape change: approaches and applications. Cambridge, UK: Cambridge University Press: 125-162.

Pregitzer, Kurt S.; Laskowski, Michele J.; Burton, Andrew J.; Lessard, Veronica C.; Zak, Donald R. 1998. Variation in sugar maple root respiration with root diameter and soil depth. Tree Physiology. 18: 665-670.

Pregitzer, Kurt S.; Zak, Donald R.; Maziasz, Jennifer; DeForest, Jared; Curtis, Peter S.; Lussenhop, John. 2000. Interactive effects of atmospheric CO2 and soil-N availability on fine roots of Populus. Ecological Applications. 10(1): 18-33.

Yin, Xiwei. 1999. Bright sunshine duration in relation to precipitation, air temperature and geographic location. Theoretical and Applied Climatology. 64: 61-68.

Yin, Xiwei. 1999. The decay of forest woody debris: numerical modeling and implications based on some 300 data cases from North America. Oecologia. 121: 81-98.

Zak, Donald R.; Pregitzer, Kurt S.; Curtis, Peter S.; Holmes, William E. 2000. Atmospheric CO2 and the composition and function of soil microbial communities. Ecological Applications. 10(1): 47-59.

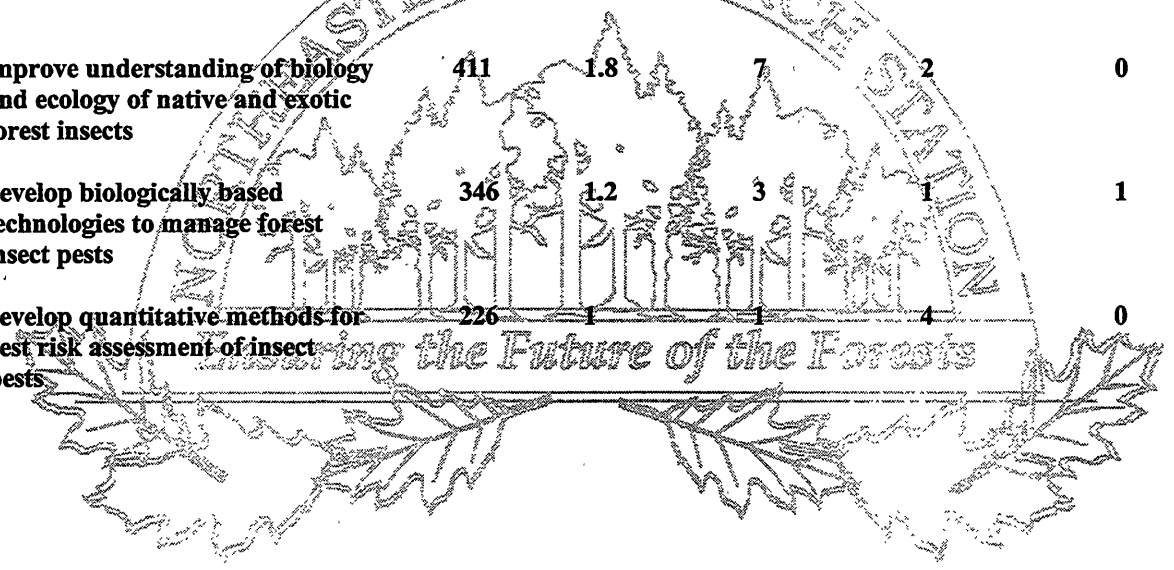
Zak, Donald R.; Pregitzer, Kurt S.; King, John S.; Holmes, William E. 2000. Elevated atmospheric CO2, fine roots and the response of soil micro-organisms: a review and hypothesis. New Phytologist. 147: 201-222.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4501

Role of Forest Insect Biology and Biocontrol in Maintaining Forest Health
Shields, Kathleen S, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Improve understanding of biology and ecology of native and exotic forest insects	411	1.8	7	2	0
2. Develop biologically based technologies to manage forest insect pests	346	1.2	3	1	1
3. Develop quantitative methods for pest risk assessment of insect pests	226	1	1	4	0



NORTHEASTERN RESEARCH STATION
Research Unit NE-4501

Problem 1 Improve understanding of biology and ecology of native and exotic forest insects

Publications

Research

Keena, Melody A. 2000. Anoplophora glabripennis (Coleoptera: Cerambycidae) fecundity and egg viability on Acer saccharum in the laboratory. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency forum on gypsy moth and other invasive species 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 21. Abstract.

Keena, Melody A. 2000. Anoplophora glabripennis from egg to adult. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency forum on gypsy moth and other invasive species 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 22. Abstract.

Keena, Melody A. 2000. Anoplophora glabripennis from egg to adult. Poster presentation at the national meeting, Entomological Society of America; 1999 December 12-16; Atlanta, GA. Poster.

Sanchez, V.; Carde, R. 1999. Isozyme patterns and their inheritance in the tachinid Compsilura concinnata. The Journal of Heredity. 90(5): 568-573.

Sanchez, Vicente. 1999. Electrophoretic variability and differences in flight potential of Lymantria dispar. Poster presentation; 10th annual New England molecular evolutionary biologists meeting; 1999 November 6; University of Albany, Albany, NY. Poster.

Sanchez, Vicente. 2000. Genetic variability in gypsy moth females differing in flight potential. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency forum on gypsy moth and other invasive species 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 41-42. Abstract.

Shields, Kathleen S.; Mikus, David R. 2000. A preliminary description of antennal sensory receptors of Anoplophora glabripennis. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency forum on gypsy moth and other invasive species 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 55. Abstract.

Extramural

Charlton, Ralph E.; Carde, Ring T.; Wallner, William E. 1999. Synchronous crepuscular flight of female Asian gypsy moths: relationships of light intensity and ambient and body temperatures. Journal of Insect Behavior. 12(4): 517-531.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4501

Extramural

Zolubas, Paulius; Ziogas, Algimantas; Shields, Kathleen. 1999. Gypsy moth female (Lymantria dispar L.) flight potential in Lithuania. Baltic Forestry. 5(2): 45-48.

Attainment

Research was completed on a number of aspects of the biology and ecology of gypsy moth, a gypsy moth parasitoid, Asian gypsy moth, and Asian longhorned beetle. Isozyme patterns and their inheritance were determined for the tachinid parasitoid, Compsilura concinnata. Relationships of light intensity and ambient and body temperatures were determined in synchronous crepuscular flight of Asian gypsy moths and the flight potential of gypsy moth populations in Lithuania was analyzed. Genetic variability of worldwide gypsy moth populations was compared to flight potential of female moths. Research was initiated on Asian longhorned beetle and data were collected on fecundity, egg viability, larval development rates, and survivorship in cut logs. An initial assessment was made of antennal sensory receptors that might function as chemoreceptors.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4501

Problem 2 Develop biologically based technologies to manage forest insect pests

Publications

Research

Nathan P.; Montgomery, Michael E. 2000. Impact of a Chinese lady beetle on hemlock woolly adelgid: initial field cage study. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency forum on gypsy moth and other invasive species 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 19. Abstract.

Montgomery, Michael E.; Yao, Defu; Wang, Hongbin. 2000. Chinese Coccinellidae for biological control of the hemlock woolly adelgid: description of native habitat. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 97-102.

Souto, Dennis R.; Shields, Kathleen S. 2000. Overview of hemlock health. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings; Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 76-80.0

Cooperative

McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R. 2000. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America. 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 237.

Extramural

Yu, Guoyue; Montgomery, Michael E.; Yao, Defu. 2000. Lady beetles (Coleoptera: Coccinellidae) from Chinese hemlocks infested with the hemlock woolly adelgid, Adelges tsugae Annand (Homoptera: Adelgidae). The Coleopterists Bulletin. 54(2): 154-199.

Attainment

Biologically based technologies are being developed to manage populations of hemlock woolly adelgid, a non-native pest of eastern hemlock. A symposium was convened to discuss methodologies and current research directed toward sustainable management of hemlock ecosystems in North America and unit members participated and took the lead in compiling the symposium proceedings. Lady beetles from China have been evaluated as biological controls for hemlock woolly adelgid; descriptions of 20 new species have been published and their native habitats have been described. Two of these species (Scymnus sinuanodulus and S. ningshanensis) were determined to have good potential to reduce damage caused by hemlock woolly adelgid. Their comparative biology has been described. Initial field cage studies of S. sinuanodulus have been completed and showed that this predator can have an impact on hemlock woolly adelgid.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4501

Problem 3 Develop quantitative methods for pest risk assessment of insect pests

Research

Wallner, William E. 1999. Invasive forest pests: international problems associated with solid-wood packing material. In: Goheen, Ellen Michaels, comp. Proceedings of the 5th joint meeting of the western international forest disease work conference and western forest insect work conference; 1999 September 13-17; Breckenridge, CO. Central Point, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 171-175.

Extramural

Bonneau, Laurent R.; Shields, Kathleen S.; Civco, Daniel L. 1999. A technique to identify changes in hemlock forest health over space and time using satellite image data. Biological Invasions. 1: 269-279.

Bonneau, Laurent R.; Shields, Kathleen S.; Civco, Daniel L. 1999. Using satellite images to classify and analyze the health of hemlock forests infested by the hemlock woolly adelgid. Biological Invasions. 1: 255-267.

Bonneau, Laurent R.; Shields, Kathleen S.; Civco, Daniel L.; Mikus, David R. 2000. Classification and spatial analysis of eastern hemlock health using remote sensing and GIS. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. 267. Newtown Square, PA; U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 176. Poster.

Bonneau, Laurent R.; Shields, Kathleen S.; Civco, Daniel L.; Mikus, David R. 2000. Use of satellite image data to identify changes in hemlock health over space and time. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. 267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 175. Poster.

Attainment

Non-native invasive insects have a major impact on eastern forests and the threat of additional introductions continues; hence, better methods are needed to improve pest risk assessments and to identify forests most vulnerable to specific non-native pests. Working in cooperation with APHIS, other Forest Service groups, and international scientists, the unit has developed criteria to predict which non-native insects possess dangerous invasive capabilities and has worked to improve pest risk assessments of unprocessed wood. Methodology has been developed to use satellite images to classify and analyze the health of hemlock forests infested by hemlock woolly adelgid and to identify changes in hemlock forest health over space and time.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4502

Pathology and Microbial Control of Insects That Impact the Health of Eastern Forests
McManus, Michael L, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Develop the technology to optimize performance of Bt against native and exotic defoliating insects	100	6	2	0	0
2. Optimize production and performance of GYPCHEK against the gypsy moth and understand NPV epizootiology	562	1.5	5	0	1
3. Accelerate the use of entomopathogens against invasive and newly-established forest pests	108	.9	10	0	0
M1. Determine the effect of microbial pesticides and non-indigenous pathogens against non-target organisms	0	0	1	1	0

NORTHEASTERN RESEARCH STATION
Research Unit NE-4502

Problem 1 Develop the technology to optimize performance of Bt against native and exotic defoliating insects

Publications

Research

Mierzejewski, Karl; Reardon, Richard C.; Dubois, Normand. 2000. Conventional application equipment: aerial application. In: Lacey, Lawrence A.; Kaya, Harry K., comps., eds. Field manual of techniques in invertebrate pathology. Dordrecht, Netherlands: Kluwer Academic Publishers: 113-151.

van, Frankenhuyzen, K.; Reardon, R.C.; Dubois, N.R. 2000. Forest defoliators. In: Lacey, Lawrence A.; Kaya, Harry K., comps., eds. Field manual of techniques in invertebrate pathology. Dordrecht, Netherlands: Kluwer Academic Publishers: 527-556.

Attainment

The (Bacillus thuringiensis) product NOVODOR was tested against Asian Longhorned beetle (ALB) larvae and adult males using standard bioassay procedures. No mortality was realized although NOVODOR caused a negative effect on weight gain of larvae. We then initiated studies to determine the feasibility of using voltage clamp assays to test the susceptibility of ALB larvae to (Bacillus thuringiensis) Cry toxins. Collaborative research was initiated with Dr. Donald Dean, Ohio State University, to evaluate novel Cry toxins and to determine the location of binding sites on the midgut membrane.

Cooperative studies with the Chinese Academy of Forestry, Beijing were initiated in China and facilitated by a work-visit in July. Objectives were (A) to bioassay five strains of Bacillus thuringiensis against ALB adults, (B) to collect diseased beetles from native populations in China and (C) collect ALB larvae for use in the Ansonia Quarantine Facility rearing program. Plans are being formulated to host one or more Chinese scientists in the next fiscal year and to enhance scientific exchanges in future years.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4502

Problem 2 **Optimize production and performance of GYPCHEK against the gypsy moth and understand NPV epizootiology**

Publications

Research

D'Amico, Vincent; Elkinton, Joseph S.; Podgwaite, John D. 2000. Nonlinear transmission of the gypsy moth NPV. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency gypsy moth research forum 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 8. Abstract.

Miller, David R.; Stoughton, Thomas E.; Thorpe, Kevin; Podgwaite, John; Steinke, William; Huddleston, Ellis W.; Ross, James B. 1999. Air stability effects on spray drift. In: Proceedings of 1999 NAAA/ASAE joint technical session; 1999 December 13-13; Pap. No. AA99-003. Reno, NV. St. Joseph, MI: American Society of Agricultural Engineers: AA99-003: 1-11.

Webb, R.E.; Podgwaite, J.D.; Schumacher, D.; Diss, A.; White, G.B.; Reardon, R.C.; Sukontarak, T. 1999. Estimating the biological efficacy of Gypchek aerially-applied against a low-density leading-edge gypsy moth population. In: Proceedings of the 1999 annual gypsy moth review; 1999 November 1-4; Madison, WI. Madison, WI: Wisconsin Department of Agriculture, Trade and Consumer Protection: 133. Abstract.

Webb, R.E.; Shapiro, M.; Thorpe, K.W.; Peiffer, R.A.; Fuester, R.W.; Valenti, M.A.; White, G.B.; Podgwaite, J.D. 2000. Potentiation by a granulosis virus of Gypchek, the gypsy moth nuclear polyhedrosis product: field confirmation. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency gypsy moth research forum 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station.: 69. Abstract.

Webb, R.E.; Thorpe, K.W.; Podgwaite, J.D.; Reardon, R.C.; White, G.B.; Talley, S.E. 2000. Efficacy of Gypchek against the gypsy moth (Lepidoptera: Lymantriidae) and residual effects in the year following treatment. Journal of Entomological Science. 34(4): 404-414.

Cooperative

Podgwaite, John D. 1999. Recommendations for and limitations to the successful use of Gypchek. In: Proceedings of the 1999 annual gypsy moth review; 1999 November 1-4; Madison, WI. Madison, WI: Wisconsin Department of Agriculture, Trade, and Consumer Protection: 147-148. Abstract.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4502

Problem 3 Use of biotechnology to generate solutions to problems supporting current research

Attainment

No progress to report this period.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4502

Attainment

The gypsy moth specific viral pesticide Gypchek continues to be produced by project personnel in cooperation with the APHIS Methods Development Center on Cape Cod, MA. In FY-2000, over 5800 acres containing environmentally sensitive habitats in Michigan and Ohio were treated in conjunction with state and federal cooperative suppression and eradication programs. Collaborative laboratory and field studies with ARS and university scientists confirmed that activity of Gypchek can be enhanced 10-fold when it is applied with (Helicoverpa armigira) granulovirus virus (GV). The GV codes for a protein (enhancin) which is responsible for the increase in Gypchek activity. The feasibility of adding enhancers to Gypchek formulations will be considered following further testing in collaboration with ARS scientists. A pilot test of a single aerial application of Gypchek in the commercially produced Carrier 038 was conducted in Maryland and West Virginia collaboratively with S&PF and ARS personnel. In addition to acceptable results in the year of treatment, second-year effects suggested that Gypchek applications may be particularly desirable in situations where natural virus is low or absent. Results give forest managers the option of using one application (full dose) or two applications (split dose) against the gypsy moth. A study with ARS, S&PF, Wisconsin DNR and Wisconsin Department of Agriculture scientists was conducted to estimate the efficacy of Gypchek aerially applied against low-density leading-edge gypsy moth populations in Wisconsin. A "bugs-in-bag" technique was used to estimate larval mortality following application. A single application performed well but was sensitive to weather conditions. Results will be valuable in planning operational Gypchek treatments within the Forest Service's "slow-the spread" program. Gypsy moth nucleopolyhedrosis virus (NPV) epizootiology continues to be studied by project personnel and through cooperation with University of Massachusetts scientists. A field experiment has shown that spatial clumping of NPV inoculum on leaves accounts for non-linearity of NPV transmission rates in browsing larvae. This information is useful in modeling NPV dynamics and for inclusion in gypsy moth management models.

Results from the above mentioned studies have been communicated either through presentations before scientific societies or through published manuscripts.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4502

Problem 3 Accelerate the use of entomopathogens against invasive and newly-established forest pests

Publications

Research

Hajek, Ann E.; Delalibera, Italo, Jr.; McManus, Michael L. 2000. Introduction of exotic pathogens and documentation of their establishment and impact. In: Lacey, Lawrence A.; Kaya, Harry K., comps., eds. Field manual of techniques in invertebrate pathology. Dordrecht, Netherlands: Kluwer Academic Publishers: 339-369.

Hylis, Miroslav; Vavra, Jiri; Maddox, Joseph V.; McManus, Michael L.; Weiser, Jaroslav.1999. Characterization of three microsporidian isolates from the gypsy moth (Lymantria dispar L.): their developmental cycle and tissue specificity. Journal of Eukaryotic Microbiology. 46(1): 9A. Abstract.

McManus, Michael L. 1998. Integrated forest pest management in the United States. In: Proceedings of the jubilee international conference, forests and forestry research for the 3rd millennium; 1998 October 11-14; Zvolen, Slovakia. [Place of publication unknown]: [Publisher name unknown]: 243-247.

McManus, Michael L. 1999. The Asian longhorned beetle: a newly introduced pest in the United States. In: Proceedings of the 2nd workshop of the IUFRO WP 7.03.10; 1999 April 20-23; Sion-Chateauneuf, Switzerland. Birmensdorf, Switzerland: Swiss Federal Institute for Forest, Snow and Landscape Research: 94-97.

Novotny, J.; McManus, M.L.; Maddox, J.V.; Solter, L.F. 2000. The importance of microsporidia in gypsy moth populations in Slovakia. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency gypsy moth research forum 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 30. Abstract.

Pilarska, D.K.; Solter, L.F.; Maddox, J.F.; McManus, M.L. 1998. Prevalence of microsporidia in Lymantria dispar L. populations in Bulgaria. 6th European Congress of Entomology; 1998 August 23-29. Czech Republic: [Place of publication unknown]: [Publisher name unknown]: 583-584. Abstract.

Pilarska, Daniela; Linde, Andreas. 1999. Morphometrical comparison of various microsporidian isolates from the gypsy moth, Lymantria dispar L. 7th European meeting in the IOBC/WPRS working group "Insect pathogens and insect parasitic nematodes," together with COST 819 "Entomopathogenic nematodes;" 1999 March 22-26; Vienna, Austria. Vienna, Austria: University of Agricultural Sciences: 41. Abstract.

Pilarska, Daniela; Solter, Leellen; Maddox, Joseph; McManus, Michael. 1998. Microsporidia from gypsy moth (Lymantria dispar L.) populations in central and western Bulgaria. Acta Zoologica Bulgarica. 50(2/3): 109-113.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4502

Research

Podgwaite, J.; Schoenfeldt, H.; Zerillo, R.; D'Amico, V. 2000. Bacteria associated with Asian longhorned beetle adults. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency gypsy moth research forum 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 32. Abstract.

Vavra, Jiri; Vossbrinck, Charles R.; Maddox, J.V.; McManus, Michael. 1999. Microsporidia of the gypsy moth in the concept of microsporidia in general. 7th European meeting in the IOBC/WPRS working group insect pathogens and insect parasitic nematodes, together with COST 819, Entomopathogenic nematodes; 1999 March 22-26, Vienna Austria. Vienna, Austria: University of Agricultural Sciences: 55. Abstract.

Cooperative

Williams, David W.; McManus, Michael L. 1999. Anoplophora glabripennis, a recent invader from China into urban forests of the United States. In: Forster, B.; Knizek, M.; Grodzki, W., eds. Proceedings of the 2nd workshop of the IUFRO WP, methodology of forest insect and disease survey in central Europe; 1999 April 20-23; Sion-Chateauneuf, Switzerland. Birmensdorf, Switzerland: Swiss Federal Institute for Forest, Snow and Landscape Research: 252-253.

Attainment

Since 1994, a team of cooperators from the U.S. and Central Europe have collected 10 isolates of microsporidia, entomopathogens specific to the gypsy moth which are being evaluated as classical biological control agents. We have determined their importance and prevalence in gypsy moth populations in several European countries, and have conducted experiments designed to evaluate methodologies for introducing these entomopathogens into low density populations. At least five of these isolates have been characterized and their host specificity has been documented. All isolates belong to the genera (Nosema) or (Vairimorpha). Studies have been initiated recently to use molecular techniques (RAPD) to assist us in ascertaining the taxonomy of the many (Nosema) isolates so that they can either be described in the literature as either new species or biotypes. These determinations are essential for us to obtain approval from Regulatory agencies in the U.S. to introduce microsporidia for classical biological control of gypsy moth populations.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4502

Problem M1. Determine the effect of microbial pesticides and non-indigenous pathogens against non-target organisms

Publications

Research

Hylis, M.; Vavra, J.; Maddox, J.V.; McManus, M.L. 1998. Host specificity of two microsporidian isolates (Protista, Microspora) from the gypsy moth, Lymantria dispar L. (Lepidoptera, Lymantriidae) for some European Lepidoptera. 6th European Congress of Entomology; 1998 August 23-29. Czech Republic: [Place of publication unknown]: [Publisher name unknown]: 572-573. Abstract.

Extramural

Hohn, F.M.; Wagner, D.L. 2000. Larval substrates of herminiine noctuids (Lepidoptera): macrodecomposers of temperate leaf litter. Environmental Entomology. 29(2): 207-212.

Attainment

No Progress to report this period.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4505

Disturbance of Eastern Forest Ecosystems by Stressor/Host/Pathogen Interactions
Wargo, Philip M, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Relationship of stessor/host/pathogen and site interactions to forest maturation, disturbance, and gap formation is poorly understood	416	1.9	2	5	0
2. Too few dependable early indicators of forest tree vulnerability to disturbance from stressor/host/pathogen interactions	491	2.3	3	0	0
3. Tools are inadequate to predict, prevent, and mitigate disturbances that threaten forest sustainability and management objectives	146	.8	2	0	0

NORTHEASTERN RESEARCH STATION
Research Unit NE-4505

Problem 1 Relationship of stessor/host/pathogen and site interactions to forest maturation, disturbance, and gap formation is poorly understood

Publications

Research

Shortle, Walter C.; Smith, Kevin T.; Minocha, Rakesh; Minocha, Subhash; Wargo, Philip M.; Vogt, Kristina A. 2000. Tree health and physiology in a changing environment. Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 229-274.

Wargo, Philip M.; Auclair, Allan N.D. 2000. Forest declines in response to environmental change. In: Mickler, Robert A.; Birdsey, Richard A,; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 117-145.

Cooperative

Williams, David W.; Long, Robert P.; Wargo, Philip M.; Liebhold, Andrew M. 2000. Effects of climate change on forest insect and disease outbreaks. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 455-494.

Extramural

Filley, T.R.; Hatcher, P.G.; Shortle, W.C.; Praseuth, R.T. 2000. The application of 13C-labeled tetramethylammonium hydroxide (13C-TMAH) thermochemolysis to the study of fungal degradation of wood. Organic Geochemistry. 31: 181-198.

Houston, Daniel B: Houston, David R. 2000. Allozyme genetic diversity among Fagus grandifolia trees resistant or susceptible to beech bark disease in natural populations. Canadian Journal of Forest Research. 30: 778-789.

Hughes, Monica; Wargo, Phil; Worrall, James; Weir, Alex; Rogers, Scott. 2000. Root disease and fungal communities in a forest ecosystem. Inoculum (suppl. to Mycologia) 51(3):37. Abstract.

Lawrence, Gregory B.; Vogt, Kristina A.; Vogt, Daniel J.; Tilley, Joel P.; Wargo, Philip M.; Tyrrell, Margaret. 2000. Atmospheric deposition effects on surface waters, soils, and forest productivity. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 275-330.

Vogt, Kristina A.; Vogt, Daniel J.; Boon, Paul; Franzeres, Anna; Wargo, Philip M.; Palmiotto, Peter A. 1999. A non-value based framework for assessing ecosystem integrity. In: Meurisse, Robert T.; Ypsilantis, William G.; Seybold, Cathy, eds. Proceedings, Pacific Northwest forest and rangeland soil organism symposium; 1998 March 17-19; Corvallis, OR. Gen. Tech. Rep. PNW-GTR-461. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 3-20.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4505

Attainment

Study areas across northern New England were established following the 1998 regional ice storm. Tree survival and vigor of hardwood trees with various amounts of crown injury were recorded through the summer of 2000.

Prescribed fire and the role of compartmentalization in survival of fire-adapted central hardwoods continues to be investigated at the Vinton Furnace Experimental Forest in central Ohio.

Study areas were established in the Neversink Valley of the upper Delaware River Basin along a gradient of base cation availability from ridge top to lower slope. Samples of soil, tree stems, and tree crowns were taken to establish current relationships among soil base status, foliar stress as indicated by polyamine and amino acid levels, and stem growth and to look for evidence of changing soil conditions over the past century due to acid deposition.

Preliminary data from microbial biomass seasonal studies in red spruce stands suggest that there is a relationship between microbial populations and soil chemistry of the forest floor. Both microbial biomass and colony forming units (CFU's) of bacteria and fungi were higher in stands with high Ca/Al ratios compared to stands with low Ca/Al ratios. Results also indicated distinct seasonal differences; soil samples in June had higher levels of biomass and CFU's than August or October. August levels were probably affected by the severe drought. A laboratory microcosm experiment will be initiated to specifically examine the effects of changes in pH and soil cation chemistry on microbial biomass in the forest floor.

NORTHEASTERN RESEARCH STATION
Research Station NE-4505

Problem 2 Too few dependable early indicators of forest tree vulnerability to disturbance from stressor/host/pathogen interactions

Publications

Research

Minocha, Rakesh; Long, Stephanie; Magill, Alison H.; Aber, John; McDowell, William H. 2000. Foliar free polyamine and inorganic ion content in relation to soil and soil solution chemistry in two fertilized forest stands at the Harvard Forest, Massachusetts. Plant and Soil. 222(1-2): 119-137.

Shortle, Walter C.; Minocha, Rakesh. 1999. Taxol: a review. In: Raychaudhuri, S.P.; Maramorosch, Karl, comps., eds. Biotechnology and plant protection in forestry science. Enfield, NH: Science Publishers, Inc: 1-11.

Smith, Kevin T.; Cufar, Katarine; Levani, Tom. 1999. Temporal stability and dendroclimatology in silver fir and red spruce. Phyton [Horn, Austria]. 39(3): 117-122.

Cooperative

Sutherland, E. Kennedy; Smith, K.T. 2000. Wound characteristics in common central hardwood trees after prescribed burning. In: Communicating & advancing technology: Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 132. Abstract.

Attainment

Dissections of northern hardwoods in ice storm study areas were used to determine patterns of wood discoloration and decay. Dissection sessions were used as demonstrations of tree injury and recovery with customer groups such as the White Mountain National Forest and the New Hampshire Timberland Owners Association.

Tree dissections were used to determine patterns of wood discoloration and decay following prescribed fire in central hardwood stands. The relationship of tree injury to bark thickness, bark textures, and micro-environmental factors was investigated.

Samples of dated stemwood from sugar maple from the Catskills of New York, southern beech from Tierra del Fuego, red spruce from the Adirondacks of New York, and Siberian fir from Russia were prepared for strontium isotope analysis, which may indicate a change in rooting depth of trees due to the influence of acid deposition.

Sugar maples in lime amended plots had lower levels of reducing sugars and sucrose in the bark and wood of roots compared to unlimed plots. This reduction, accompanied by an increase in starch levels, indicates a return to normal carbohydrate production, transportation, and metabolism in response to higher base cation availability.

NORTHEASTERN RESEARCH STATION
Research Station NE-4505

Problem 3 **Tools are inadequate to predict, prevent, and mitigate disturbances that threaten forest sustainability and management objectives**

Publications

Research

Smith, Kevin T.; Shortle, Walter C. 2000. Patterns of tree injury and response to ice storm 1998. In: Fosbroke, Sandra L.C., Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency research forum on gypsy moth and other invasive species 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 59. Abstract.

Smith, Kevin; Oven, Primoz. 2000. Arboriculture in Ljubljana, Slovenia. Arborist News. 9(4): 43-45.

Attainment

Visual markers of susceptibility to initial injury and subsequent damage from storms are being developed from research at the ice storm study areas in northern New England.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4509

Development of Biologically Based Controls for Insect Pests and Diseases Through Molecular Technologies
Slavicek, James M, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Fundamental development of biological agents and biorational approaches for insect control	680	2.9	8	4	0
2. Develop biological and biorational approaches for control of tree diseases	486	2	3	0	0
3. Use of biotechnology to generate solutions to problems supporting current research	5	.1	0	0	0

NORTHEASTERN RESEARCH STATION
Research Unit NE-4509

Problem 1 Fundamental development of biological agents and biorational approaches for insect control

Publications

Research

Garner, Karen J.; Validities, Algimantas P. 2000. Cloning and characterization of four distinct gypsy moth midgut amino peptidase-N enzymes related to the Bacillus thuringiensis Cry1Ac receptor. In: Society for Invertebrate Pathology 33rd annual meeting; 2000 August 13-18; Guanajuato, Mexico. [Place of publication unknown]: [Publisher name unknown]: Poster BP26: 42. Abstract.

Garner, Karen J.; Valaitis, Algimantas P. 2000. Cloning and sequencing of BTR-CAD, a gypsy moth midgut protein related to a putative receptor for the insecticidal toxins of Bacillus thuringiensis. In: Society for Invertebrate Pathology 33rd annual meeting; 2000 August 13-18; Guanajuato, Mexico. [Place of publication unknown]: [Publisher name unknown]: Poster BP-52: 42. Abstract.

Hiremath, S.T.; Podila, G.K. 2000. Development of genetically engineered mycorrhizal fungi for biological control. In: Podila, Gopi K.; Douds, David D., Jr., comps., eds. Current advances in mycorrhizae research. Symposium Series. St. Paul, MN: APS Press, American Phytopathological Society: 179-187.

Popham, Holly J.R.; Bischoff, David S.; Mercer, Melissa J.; Slavicek, James M. 2000. Characterization of the 122b isolate of LdMNPV. In: Society for Invertebrate Pathology 33rd annual meeting; 2000 August 13-18; Guanajuato, Mexico. [Place of publication unknown]: [Publisher name unknown]: 81. Abstract.

Slavicek, J.M. 2000. Development of improved strains of the Lymantria dispar nuclear polyhedrosis virus. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency research forum on gypsy moth and other invasive species 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 56.

Slavicek, J.M.; Kelly, M.E.; Mercer, M.; Hayes-Plazolles, N. 2000. A mutation in ORF 134 of the LdMNPV causes production of abnormally large polyhedra. In: American Society for Virology; 19th annual meeting; 2000 July 8-12; Fort Collins, CO. Scientific program and abstracts. [Place of publication unknown]: [Publisher name unknown]: P16-6. 161. Abstract.

Slavicek, J.M.; Popham, H.J.R.; Bischoff, D.S. 2000. Molecular characterization of a second enhancin gene homology in the Lymantria dispar nuclear polyhedrosis virus. In: Fosbroke, Sandra L.C.; Gottschalk, Kurt W., eds. Proceedings, U.S. Department of Agriculture interagency research forum on gypsy moth and other invasive species 2000; 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 58.

Zheng, J.; Balasubramanian S.; Podila, G.K.; Hiremath, S.T. 2000. Expression of acetyl-CoA acetyltransferase in an ectomycorrhizal fungus Laccaria bicolor during symbiosis. Phytopathology. 90(6) (Supple.): S88. Abstract.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4509

Extramural

Audtho, Mongkon; Valaitis, Algimantas P.; Alzate, Oscar; Dean, Donald H. 1999. Production of chymotrypsin-resistant Bacillus thuringiensis Cry2Aal Delta-endotoxin by protein engineering. Applied and Environmental Microbiology. 65(10): 4601-4605.

Balasubramanian, S.; Hiremath, S.T.; Podila, G.K. 2000. Cloning and characterization of symbiosis-regulated malate synthase from the ectomycorrhizal fungus Laccaria bicolor. Phytopathology. 90(6) (Suppl.): S5. Abstract.

Jenkins, Jeremy l.; Lee, Mi Kyong; Valaitis, Algimantas P.; Dean, Donald H.. Bivalent sequential binding model of a Bacillus thuringiensis toxin to gypsy moth aminopeptidase N receptor. The Journal of Biological Chemistry. 275(19): 14423-14431.

Sundaram, S.; Hiremath, S.T.; Podila, G.K. 2000. Cloning of a ras gene from an ectomycorrhizal fungus Laccaria bicolor and characterization of its symbiosis-regulated expression. Phytopathology. 90(6) (Suppl.): S75. Abstract.

Attainment

Gypsy moth virus research: A second enhancin gene was identified in the Lymantria dispar nucleopolyhedrovirus (LdMNPV) and was characterized through sequence and transcriptional analysis. Deletion of this gene reduced viral potency by about 2 fold. An LdMNPV polyhedron formation mutant was isolated and was found to contain a mutation in open reading frame (ORF) 134 within the viral genome. This ORF regulates the number of polyhedra produced and their size. In previous studies, a strain of LdMNPV was isolated that exhibited stable polyhedra production during serial passage. The gene responsible for this trait in isolate 122b was localized within a 15 kb region within the viral genome. Bacillus thuringiensis research: Understanding the mechanism of toxin binding to midgut receptors helps direct continuing efforts in engineering Bacillus thuringiensis (B.t.) toxins with higher toxicity and specificity. Two types of B.t. toxin receptors have been identified in insect pests. One is an aminopeptidase N (APN) and the other is a cadherin-like protein. Four APNs and the cadherin-like protein B.t. toxin receptor (BTR-CAD) from gypsy moth (Lymantria dispar) were cloned and sequenced. Comparing mutant toxin binding affinities to L. dispar APN using an optical biosensor revealed that B.t. Cry1Ac toxin binds to L. dispar APN localized to specific residues in domain II & III of Cry1Ac in sequential manner.

Mycorrhizal research: Fundamental understanding of the molecular basis of the symbiotic interaction between mycorrhizal fungi and plant host is essential for capturing all the benefits that mycorrhizae can offer to forestry. Utilization of carbon energy sources is very important during symbiosis, since the fungi are dependent upon the plant partner to provide the carbon for their survival. We have isolated and characterized L. bicolor malate synthase and acetyl-CoA acetyl transferase genes that are activated during symbiosis. In addition, a L. bicolor ras gene, potentially involved in the growth and proliferation of mycorrhizal fungi, was cloned and characterized. Efforts are being made to genetically engineer the fungus by introducing value-added genes.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4509

Problem 2 Develop biological and biorational approaches for control of tree diseases

Publications

Research

Koch, J.; Creelman, R.A.; Eshita, S.M.; Davis, K.R. 2000. Molecular mechanisms leading to ozone-induced lesion formation in hybrid poplar. In: Air pollution, global change and forests in the new millennium; the 19th international meeting for specialists in air pollution effects on forest ecosystems; 2000 May 28-31; Houghton, MI. [Place of publication unknown]: [Publisher name unknown]: 45. Abstract.

Koch, Jennifer Riehl. 1999. The molecular basis for ozone sensitivity in hybrid poplar. Columbus, OH: The Ohio State University: Ph.D. Dissertation. 145.

Koch, Jennifer Riehl; Creelman, Robert A.; Eshita, Steven M.; Seskar, Mirjana; Mullet, John E.; Davis, Keith R. 2000. Ozone sensitivity in hybrid poplar correlates with insensitivity to both salicylic acid and jasmonic acid. The role of programmed cell death in lesion formation. Plant Physiology. 123: 487-496.

Attainment

Comparisons of patterns of defense response gene expression between an ozone-tolerant and an ozone-sensitive hybrid poplar clone indicated that ozone-, pathogen-, and wound-induced expression of both salicylic acid- and jasmonic acid-regulated defense genes is attenuated in the ozone-sensitive clone. Further analysis indicated this was due to the insensitivity of this clone to the plant signal molecules salicylic acid (SA) and jasmonic acid (JA). Assays were performed to detect DNA fragmentation associated with programmed cell death (PCD), a characteristic of the pathogen-induced defense response termed the hypersensitive response. DNA fragmentation was detected in both ozone-treated and pathogen-inoculated tissue from the tolerant clone but not the sensitive clone, indicating that the mechanism of lesion formation differs between the two clones. (In the tolerant clone, lesion formation occurs via an SA-dependent PCD pathway, while in the sensitive clone lesions are likely the result of necrosis caused by the lack of SA-induced antioxidant defenses). Dutch elm disease research: Cell suspension cultures of Dutch elm disease (DED)-tolerant and DED-susceptible American elm clones have been established and characterized as prerequisites for studies of elm cellular responses to fungus-derived elicitors and fungus-conditioned media. Cell growth, monitored by light scattering and media conductivity, indicated relatively low variances among replicates within a genotype and no significant differences in between-genotype contrasts. Culture growth was reproducible for different initiations and culture cells were stable and essentially homogeneous after five subculture passages.

DNA based identification methods were used to identify armillary fungus species on samples collected in a sugar maple decline study.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4509

Problem 3 **Use of biotechnology to generate solutions to problems supporting current research**

Attainment

DNA based identification methods were used to identify armillary fungus species on samples collected in a sugar maple decline study.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4557

Disturbance Ecology and Management of Oak-Dominated Forests
Gottschalk, Kurt W, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Vegetation dynamics in response to gypsy moth defoliation, other exotic organisms, and disturbances	58	.5	2	0	0
2. Landscape-scale population dynamics of gypsy moth and its use to develop management decisions	591	1	1	0	0
3. Silvicultural treatments for rehabilitating and regenerating oak forests	254	1.5	1	2	0
4. Models and decision support tools that synthesize and integrate disturbance effects and dynamics	223	1	0	1	0
M1. Maintain long-term studies of gypsy moth silvicultural practices and transfer technology to users	140	.4	1	0	0

NORTHEASTERN RESEARCH STATION
Research Unit NE-4557

Problem 1 Vegetation dynamics in response to gypsy moth defoliation, other exotic organisms, and disturbances

Publications

Research

Muzika, R.M.; Liebhold, A.M. 1999. Changes in radial increment of host and nonhost tree species with gypsy moth defoliation. Canadian Journal of Forest Research. 29: 1365-1373.

Muzika, R.M.; Stephenson, S.L.; Adams, H.S.; Lawrence, D.M.; Miller, G.W. 1999. Patterns of woody species composition on the Fernow Experimental Forest and adjacent portions of the Otter Creek Wilderness Area. In: Eckerlin, Ralph R., ed. 1999 Proceedings of the Appalachian Biography Symposium; 1999 June 25-29; Blacksburg, VA. Blacksburg, VA: Virginia Museum of Natural History: 35-44.

Attainment

Ring widths from 1458 trees from Massachusetts, New York, and New Jersey were measured to determine the influence of gypsy moth (Lymantria dispar L.) defoliation on both hosts (primarily oaks (Quercus spp.) and nonhosts. Previous year's defoliation negatively influenced radial increment in all oak species. Defoliation also negatively affected radial growth of pitch pine (Pinus rigida Mill.), an intermediate host. There was little or no effect of defoliation on increment of trembling aspen (Populus tremuloides Michx.) and bigtooth aspen (Populus grandidentata Michx.), but both are preferred hosts. Defoliation of host trees in mixed stands resulted in increased increment in the nonhosts tulip-tree (Liriodendron tulipifera L.) and ash (Fraxinus spp.) in the year following defoliation. The effect of defoliation was also evident in the relative production of earlywood and latewood with a pronounced dominance of earlywood production in host trees during the same year as defoliation and often in the following year.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4557

Problem 2 **Landscape-scale population dynamics of gypsy moth and its use to develop management decisions**

Publications

Research

Fosbroke, Sandra L.C.; Gottschalk, Kurt W.; eds. 2000. Proceedings, U.S. Department of Agriculture interagency research forum on gypsy moth and other invasive species. 2000 January 18-21; Annapolis, MD. Gen. Tech. Rep. NE-273. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 81.

Cooperative

Williams, David W.; Liebhold, Andrew M. 2000. Spatial scale and the detection of density dependence in spruce budworm outbreaks in eastern North America. Oecologia. 124: 544-552.

Williams, David W.; Long, Robert P.; Wargo, Philip M.; Liebhold, Andrew M. 2000. Effects of climate change on forest insect and disease outbreaks. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 455-494.

Attainment

The proceedings of the annual U.S. Department of Agriculture Interagency Research Forum on Gypsy Moth and Other Invasive Species contains 46 abstracts and papers of oral and poster presentations on gypsy moth and other invasive species biology, molecular biology, ecology, impacts, and management.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4557

Problem 3 Silvicultural treatments for rehabilitating and regenerating oak forests

Publications

Research

Miller, Gary W. 2000. Effect of crown growing space on the development of young hardwood crop trees. Northern Journal of Applied Forestry. 17(1): 25-35.

Extramural

Graves, Aaron, T.; Fajvan, Mary Ann; Miller, Gary W. 2000. The effects of thinning intensity on snag and cavity tree abundance in an Appalachian hardwood stand. Canadian Journal of Forest Research. 30: 1214-1220.

Johnson, James E.; Miller, Gary W.; Baumgras, John E.; West, Cynthia D. 1999. An assessment of residual stand conditions following shelterwood-with-reserves cuts in Appalachian hardwoods. In: Haywood, James E., ed. Proceedings of the 10th biennial southern silvicultural research conference; 1999 February 15-18; Shreveport, LA. Gen. Tech. Rep. SRS-30. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 28-33.

Attainment

Crown release of individual crop trees can be used to increase the growth and competitiveness of selected trees in young hardwood stands. Forest managers need information on the response of individual trees to such thinnings to prescribe stand treatments that meet specific management objectives. Codominant northern red oak (Quercus rubra L.), chestnut oak (Liriodendron tulipifera L.) crop trees in stands 12 to 16 yr-old were given a crown-touching release (Quercus prinus L.), black cherry (Prunus serotina Ehrh.), and yellow poplar (by cutting all adjacent trees that touched the crown of a selected crop tree. A heavier thinning, which entailed cutting all competing trees whose crowns were within 5 ft of the crown of a selected crop tree, was also applied to black cherry and yellow-poplar crop trees on one study site. Stand and individual-tree response was monitored for control and treated plots for 10 yrs. Both release treatments increased periodic stand basal area growth and had a negligible effect on the proportion of high-value species among overstory trees. Individual-tree development was affected by total growing space, defined as the initial area occupied by the crop-tree crown plus the area of free growing space resulting from release. As total growing space increased, there was a positive effect on dbh, crown ratio, and crown diameter growth, and a negative effect on clear stem development. Total height growth was reduced by heavy release but not by the more moderate crown-touching release.

Problem 4 **Models and decision support tools that synthesize and integrate disturbance effects and dynamics**

Publications

Extramural

Fekedulegn, Desta; MacSiurtain, Mairitin P.; Colbert, Jim J. 1999. Parameter estimation of nonlinear growth models in forestry. Silva Fennica. 33(4): 327-336.

Attainment

Partial derivatives of the negative exponential, monomolecular, Mitcherlich, Gompertz, logistic, Chapman-Richards, von Bertalanffy, Weibull and the Richard's nonlinear growth models are presented. The application of these partial derivatives in estimating the model parameters is illustrated. The parameters are estimated using the Marquardt iterative method of nonlinear regression relating top height to age of Norway spruce (Picea abies L.) from the Bowmont Norway Spruce Thinning Experiment. Formulas that provide good initial values of the parameters are specified. Clear definitions of the parameters of the nonlinear models in the context of the system being modeled are found to be critically important in the process of parameter estimation.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4557

Problem M1 **Maintain long-term studies of gypsy moth silvicultural practices and transfer technology to users**

Publications

Research

Muzika, R.M.; Liebhold, A.M. 2000. A critique of silvicultural approaches to managing defoliating insects in North America. Agricultural and Forest Entomology. 2: 97-105.

Attainment

A variety of silviculture techniques have been suggested for managing forest defoliating insects. The objectives focus on minimizing defoliation or minimizing damage from defoliation. The theoretical foundations of many approaches have been built upon observation and correlation, and very little reliable empirical evidence exists to support the objectives of silvicultural manipulations. Existing experimental data have yielded inconsistent results. Well-designed, long-term studies are needed to clarify the effect of silviculture on defoliators and their effect on forests.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4558

Multiple Stress Interactions and Their Effects on Forest Health and Sustainability
Long, Robert P, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Determine physiological and morphological changes of trees at different stages of development	90	.4	2	0	0
2. Determine how multiple interacting stressors (abiotic and biotic agents) affect tree health	374	2.4	4	3	0
3. Determine interacting roles of nutrition and site factors on tree declines and regeneration problems	297	1.7	1	0	2

NORTHEASTERN RESEARCH STATION
Research Unit NE-4558

Problem 1 Determine physiological and morphological changes of trees at different stages of development

Publications

Research

Rebbeck, J.; Scherzer, A.J. 2000. The combined effects of five years exposure to elevated ozone and enriched carbon dioxide on the physiology and growth of Pinus strobus seedlings. In: Air pollution, global change and forests in the new millennium: the 19th international meeting for specialists in air pollution effects on forest ecosystems; 2000 May 28-31; Houghton, MI. Houghton, MI: Michigan Technological University: 71. Abstract.

Scherzer, A.J.; Rebbeck, J. 2000. Effects of five years of exposure to O3 and O3 + elevated CO2 on the seasonal and annual variation of N and P in eastern white pine (Pinus strobus L.) needles. In: Air pollution, global change and forests in the new millennium: the 19th international meeting for specialists in air pollution effects on forest ecosystems; 2000 May 28-31; Houghton, MI. Houghton, MI: Michigan Technological University: 75. Abstract.

Cooperative

Isebrands, Judson G.; Dickson, Richard E.; Rebbeck, Joanne; Karnosky, David F. 2000. Interacting effects of multiple stresses on growth and physiological processes in northern forest trees. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 149-180.

Attainment

Plantation-grown eastern white pine (Pinus strobus L.) seedlings were fumigated in open-top chambers from May-October, 1992-1996 with charcoal-filtered air (CF), ambient air (chamberless), ambient ozone (1XO3), twice ambient ozone (2XO3), or twice ambient ozone+700 ppm CO2 (2XO3+CO2). Within the fifth growing season, stem diameter growth was not significantly impacted by exposure to 2XO3 ($p>0.10$) but increased 28-50% for seedlings exposed to 2XO3+CO2. Seedling height growth was reduced 20% in 2XO3-air ($p=0.03$), but was unaffected in 2XO3+CO2-air ($p>0.10$), relative to CF-controls. Total chlorophyll content of both current and 1-yr-old needles was not impacted by the treatments ($p>0.10$). Net photosynthesis (Pn) of both 1-yr-old and current-yr needles was not impacted by 2XO3 ($p>0.10$). However, Pn of both needle ages increases 2-2.5 fold in 2XO3+CO2-air relative to CF-controls.

Attainment

In the study described above, nitrogen (N) and phosphorus (P) were analyzed in current and one-yr-old needles beginning in July 1994. Ozone alone did not significantly alter N or P in either needle age from 1994-1996. In 1994, 2XO3+CO2-air significantly reduced N concentrations up to 14% in one-yr-old needles (93 cohort). Current year needles (94 cohort) were unaffected by treatments, a pattern which continued throughout the lifespan of that needle cohort. In 1995, 2XO3+CO2-air significantly reduced N by 10-28% in current-yr needles (95 cohort), and those differences were carried over into the next season. In 1996, N and P in current-year needles (96 cohort) were not affected by the treatments. Throughout the three seasons of sampling, N was 11-65% lower and P was 26-48% lower in one-yr-old needles compared to current-yr needles. The differences in needle N and P from year to year suggest that several factors including temperature, rainfall, variations in ozone concentrations, and growth rates are important in determining the response of white pine to elevated O3 and CO2.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4558

Problem 2 Determine how multiple interacting stressors (abiotic and biotic agents) affect tree health

Publications

Research

McQuattie, Carolyn J.; Schier, George A. 2000. Response of sugar maple (Acer saccharum) seedlings to manganese. Canadian Journal of Forest Research. 30: 456-467.

McQuattie, Carolyn J.; Stephenson, Steven L. 2000. Use of analytical methods to determine heavy metal concentration or location in fruiting structures of slime molds (myxomycetes). In: Nriagu, J., ed. Proceedings, 11th annual international conference on heavy metals in the environment; 2000 August 6-10; Ann Arbor, MI. Contribution #1189. Ann Arbor, MI: University of Michigan. CD-ROM

Schier, G.A.; McQuattie, C.J. 2000. Effect of manganese on endomycorrhizal sugar maple seedlings. In: Air pollution, global change and forests in the new millennium: the 19th international meeting for specialists in air pollution effects on forest ecosystems; 2000 May 28-31; Houghton, MI. Houghton, MI: Michigan Technological University: 76. Abstract.

Schier, George A.; Mcquattie, Carolyn J. 2000. Effect of water stress on aluminum toxicity in pitch pine seedlings. Journal of Plant Nutrition. 23(5): 637-647.

Cooperative

Williams, David W.; Long, Robert P.; Wargo, Philip M.; Liebhold, Andrew M. 2000. Effects of climate change on forest insect and disease outbreaks. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 455-494.

Extramural

Gunthardt-Goerg, M.S.; Mcquattie, C.J.; Mathies, D.; Frey, B. 1999. Visible and microscopic injury in leaves of 5 deciduous tree species related to current critical ozone levels. In: Fuhrer, J.; Achermann, B., eds. Critical levels for ozone - Level II. Env. Doc. No. 111. Bern, Switzerland: Swiss Agency for Environment, Forest and Landscape: 181-185.

Gunthardt-Goerg, M.S.; McQuattie, C.J.; Maurer, S.; Frey, B. 2000. Visible and microscopic injury in leaves of five deciduous tree species related to current critical ozone levels. Environmental Pollution. 109: 489-500.

Stephenson, Steven L.; McQuattie, Carolyn J. 2000. Assessing the potential use of myxomycetes as biomonitors of heavy metals in the environment. Proceedings, West Virginia Academy of Science. 72(1): 32-33. Abstract.

Attainment

Research examining the sensitivity of sugar maple seedlings to manganese (Mn) revealed that non-mycorrhizal seedlings grown in sand with 0.1, 5, 10, 20, 40 and 80 mg Mn/L had >90% mortality for seedlings grown with 40 and 80 mg Mn/L. Cellular symptoms associated with 5 mg Mn/L and higher include irregular cell shape, increased vacuolation, and swollen mitochondria in root meristems; leaves had discrete electron-dense areas in chloroplast thylakoid membranes, increased starch in mesophyll cells, and collapse of phloem in midveins. Additional research with vesicular-arbuscular mycorrhizal (VAM) inoculated sugar maple seedlings showed both stem and root dry weight to decrease with increasing Mn levels (0.1, 1, 2, 4, 8, and 16 mg Mn/L).

Collaborative research with European scientists evaluating the critical level for ozone (O3) injury was assessed with five deciduous species. The number of symptomatic leaves per tree was significantly increased and stomatal conductance was decreased under 50% ambient + 30 nl/L O3 as compared to 'normal' senescence at 50% ambient O3. Under the above ambient conditions, cellular changes included pectinaceous cell wall protrusions, phenolic cell wall encrustations, tonoplast vesicles, and inhomogeneous, condensed/precipitated phenolic material in the vacuoles. The current European critical ozone level is supported by assessment of visible leaf symptoms rather than growth reduction.

New research is evaluating the use of slime molds as indicators of heavy metal accumulation. Stalk cells of Fuligo septica (Physarales) sampled in the Great Smoky Mountains National Park had high concentrations of Pb, Mn and Zn. Fe, Cr, Mn, Si and Al were detected as crystalline precipitates in the stalks of the fruiting bodies using transmission electron microscopy and X-ray microanalysis.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4558

Problem 3 Determine interacting roles of nutrition and site factors on tree declines and regeneration problems

Publications

Research

McQuattie, Carolyn J.; Long, Robert P.; Hall, Thomas. 2000. Anatomy and element location in roots of sugar maple seedlings from limed and unlimed forest sites. Ohio Journal of Science. 100(1): A-41. Abstract.

Cooperative

Bailey, S.W.; Horsley, S.B.; Long, R.P.; Hallett, R.A. 1999. Influence of edaphic and geologic factors on the health of sugar maple on the Allegheny Plateau. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 302. Abstract.

Hallett, R.A.; Bailely [Bailey], S.W.; Horsley, S.B.; Long, R.P. 1999. Sugar maple nutrition and health in the northeastern United States. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Long, R.P.; Horsley, S.B.; Bailey, S.W.; Lilja, P.R. 1999. Base cation additions increase growth and vigor of overstory sugar maple. In: 1999 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1999 October 31-November 4; Salt Lake City, UT. [Madison, WI]: [The American Society of Agronomy]: 307. Abstract.

Long, R.P.; Omer, J.; White, R. 2000. Sugar maple mortality on the Allegheny National Forest from 1990-1999 in relation to management and defoliation. In: Communicating & advancing ecology: 85th annual meeting; Ecological Society of America; 2000 August 6-10; Snowbird, UT. Washington, DC: Ecological Society of America: 148. Abstract.

Attainment

Continuing research on factors associated with the decline disease of sugar maple on the unglaciated Allegheny Plateau in Pennsylvania has focused on base cation nutrient status, landscape position, and defoliation history. Declining sugar maple stands have poor base cation nutrient status, as indicated by foliar and soil chemistry and a history of repeated insect defoliation. In 1990, a sugar maple health monitoring network was established in 30 stands across the Allegheny National Forest. Ten stands have had no cutting in the past 30-40 years, twelve stands were thinned within the last 15 years, and eight stands were located in recently harvested areas where only a few trees per acre, usually sugar maples, were left as residuals. Average annual sugar maple mortality from 1990-1999 was 3.2%/year in uncut stands, 2.3%/year in thinned stands, and 4.3.%/year for sugar maple residual stands. These rates exceed those reported by the North American Maple Project for a similar period in which average mortality was 0.9%/year. Both frequency and severity of defoliation caused by elm spanworm (Ennomos subsignaria), forest tent caterpillar (Malacosoma disstria), and other insects were significantly associated with high levels of sugar maple mortality.

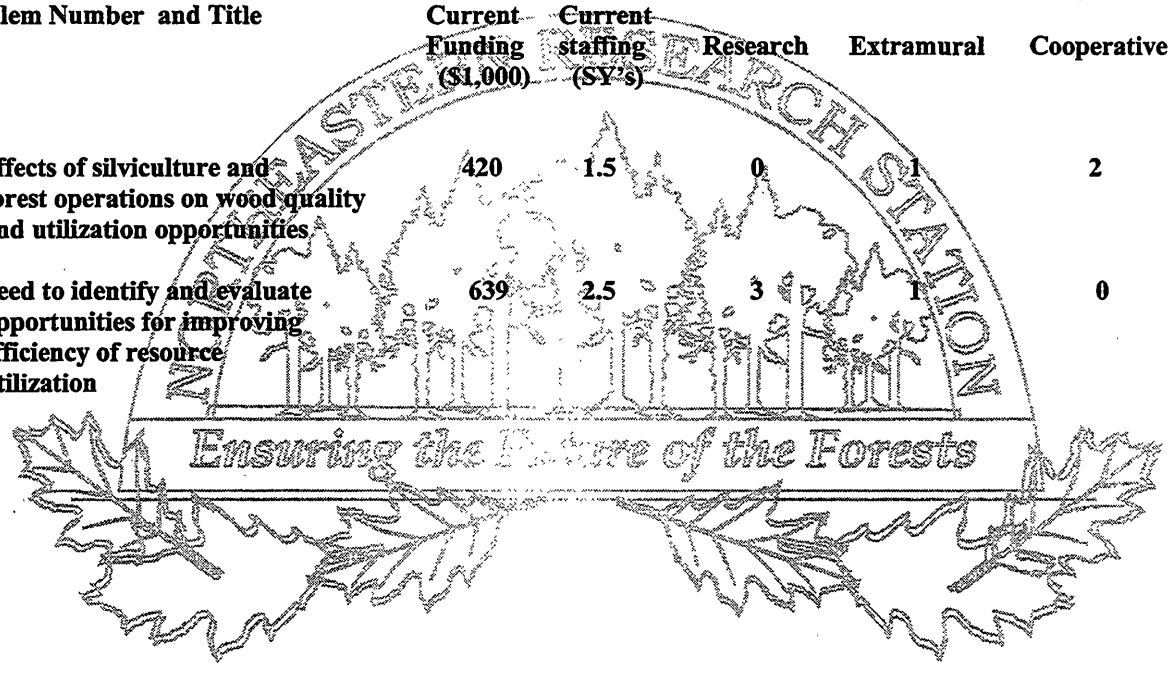
Two new cooperative research studies were initiated to evaluate varying levels of thinning and burning on oak regeneration in Pennsylvania and Ohio. In a cooperative study with NE-4557, sponsored by the Pennsylvania Bureau of Forestry, pretreatment soil and foliar samples were obtained to assess the influence of nutrition on regeneration processes. Similarly, in cooperative research with NE-4153, sponsored by the Joint Fire Science Program, pretreatment data on seedling, sapling, and overstory tree health status was collected along with a preliminary assessment of armillaria rhizomorph presence and abundance. Treatments will be initiated in the next year in both of these long-term studies.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4701

Efficient Use of the Northern Forest Resource
Baumgras, John E, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Effects of silviculture and forest operations on wood quality and utilization opportunities	420	1.5	0	1	2
2. Need to identify and evaluate opportunities for improving efficiency of resource utilization	639	2.5	3	1	0



NORTHEASTERN RESEARCH STATION
Research Unit NE-4701

Problem 1 Effects of silviculture and forest operations on wood quality and utilization opportunities

Publications

Cooperative

Baumgras, John E.; Sendak, Paul E.; Sonderman, David L. 2000. Ring shake in eastern hemlock: frequency and relationship to tree attributes. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 156-160.

Mattson, James A.; Baumgras, John E.; Blinn, Charles R.; Thompson, Michael A. 2000. Harvesting options for riparian areas. In: Verry, Elon S.; Hornbeck, James W.; Dolloff, C. Andrew.; eds. Riparian management in forests of the continental Eastern United States. Washington, DC: Lewis Publishers: 255-272.

Extramural

Pregitzer, Kurt S.; Reed, David. D.; Bornhorst, Theodore J.; Foster, David R.; Mroz, Glenn D.; McLachlan, Jason S.; Laks, Peter E.; Stokke, Douglas D.; Martin, Patrick K.; Brown, Shannon E. 1999. A buried spruce forest provides evidence at the stand and landscape scale for the effects of environment on vegetation at the Pleistocene/Holocene boundary. Journal of Ecology. 88: 1-10.

Attainment

Research progress in FY2000 includes completion of an extensive database of Detailed hardwood tree and log attributes such as form, defect types and locations, And yields - opening new avenues for research into more resource efficient hardwood processing systems and learning how tree attributes that are affected by forest management practices impact wood utilization potential. Significant progress was made in evaluating opportunities for increasing the volume and value of products from harvested timber through improved roundwood bucking and sorting practices. The modeling of relationships between external log defect indicators and internal log defects also progressed-providing information that will advance hardwood processing and optimization systems. Planning has been completed and data collection initiated on a cooperative study to evaluate the impacts of expanding hardwood markets on timber harvesting practices in West Virginia. To provide forest managers information for increasing production of high-quality and high-value hardwood timber, a series of studies linking site characteristics and silvicultural practices to wood quality are underway in Wisconsin, Ohio, Kentucky, West Virginia and Michigan. Another study initiated in FY2000 seeks to identify the chemical and mineral origins of the wood discoloration that adversely affects the quality and value of white hard maple lumber.

Problem 2 Need to identify and evaluate opportunities for improving efficiency of resource utilization

Publications

Research

Gatchell, Charles J.; Thomas, R. Edward.; Walker, Elizabeth S. 2000. Some implications of remanufacturing hardwood lumber. Forest Products Journal. 50(2): 79-89.

Hoff, Kristen. 2000. Limitations of lumber-yield nomograms for predicting lumber requirements. Gen. Tech. Rep. NE-270. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 8.

Wiedenbeck, Jan. 2000. Industrial intelligence for the solid wood manufacturing industry: best practices and performance in mill operations. In: 2nd southeastern conference on wood: producing and using wood 1999: how to increase yield, reduce waste, & recover value from the wood resource: 1999 October 12-13; Knoxville, TN. [Place of publication unknown]: [Publisher name unknown]: 1-3. Abstract.

Extramural

Steele, Philip H.; Wiedenbeck, Jan; Shmulsky, Rubin; Perera, Anura. 1999. The influence of lumber grade on machine productivity in the rough mill. Forest Products Journal. 49(9): 48-54.

Attainment

Progress in NE-4701's primary processing research includes development and testing of the beta version of the SOLV2000 Sawmill Analysis Software program in collaboration with State of Vermont cooperators. A compilation of data from 35 sawmills to develop benchmarks for lumber thickness, thickness variability, and lumber volume and value recovery is nearly complete. Primary processing research initiated in FY2000 includes cooperative studies dealing with precision end trimming of hardwood lumber, applications of real-time process controls to improve lumber recovery, impacts of log form on lumber value and volume recovery, and determining hardwood sawmill efficiency factors. The unit is also collaborating on a study funded by the Wood Education and Resource Center to develop and test a system for continuous improvement of hardwood sawmills. Collectively, these studies provide information and tools to help the hardwood sawmill industry better utilize the hardwood resource and sustain rural forest-based economies. NE-4701's secondary processing research identifies opportunities for increasing efficiency in converting lumber to finished products. FY2000 progress includes the validation of the ROMI-RIP - a widely applied rough mill yield simulation system and completion of research demonstrating the impacts of sorting capacity on rip-first rough mill yields. Cooperative studies to develop advanced methods of optimizing lumber grade mix, and optimize gang-ripsaw arbor spacings to improve conversion efficiency were initiated in FY2000.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4751

Forest Engineering Research-Systems Analysis to Evaluate Alternative Harvesting Strategies
LeDoux, Chris B, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Inadequate management planning models for forest operations and forest product transportation	120	.5	0	1	1
2. Lack of complete synthesis on all aspects of the forest operations process, selection of the harvesting process, multiproduct harvesting, loss caused by log damage and other procedures	80	.5	1	0	0

NORTHEASTERN RESEARCH
Research Unit NE-4751

Problem 1 **Inadequate management planning models for forest operations and forest product transportation**

Publications

Cooperative

Prestemon, Jeffrey P.; Pye, John M.; Abt, Karen Lee; Wear, David N.; LeDoux, Chris. 2000. Market definition for hardwood timber in the southern Appalachians. In: Munn, Ian A., Bullard, Steven H., Grado, Stephen C., and Grebner, Donald L. eds. Proceedings of the 1999 southern forest economics workshop: timbershed investments: improving the odds. 1999 April 18-20; Biloxi, MS. Mississippi State, MS: Mississippi State University: 91-98.

Extramural

Hassler, Curt C.; Grushecky, Shawn T.; LeDoux, Chris B. 2000. The effects of group selection harvest size on logging productivity. Northern Journal of Applied Forestry. 17(2): 51-56.

Attainment

A study was conducted to develop an aggregate supply model for hardwood timber for the southern Appalachians. The hypothesis tested was that harvest probability and stand age are positively related to timber value and negatively related to factors which reduce timber value. Results suggest that stand age increases with distance from mills for NIPF, industry-, and government-managed stands. Results from another study show that size of group-selection opening had little or no effect on skidding productivity. Results also suggest that additional time spent training skidder operators to hook larger payloads faster could pay dividends in increased daily production and improvements in logging profitability. The results should be valuable to forest planners and managers. Results of this research have been presented to resource managers, policy makers, loggers, and other researches through publications, symposia, and other technology transfers.

NORTHEASTERN RESEARCH
Research Unit NE-4751

Problem 2 Lack of complete synthesis on all aspects of the forest operations process, selection of the harvesting process, multiproduct harvesting, loss caused by log damage and other procedures

Publications

Research

Huyler, Neil K.; LeDoux, Chris B. 1999. Performance of a cut-to-length harvester in a single-tree and group-selection cut. Res. Pap. NE-711. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 6.

Attainment

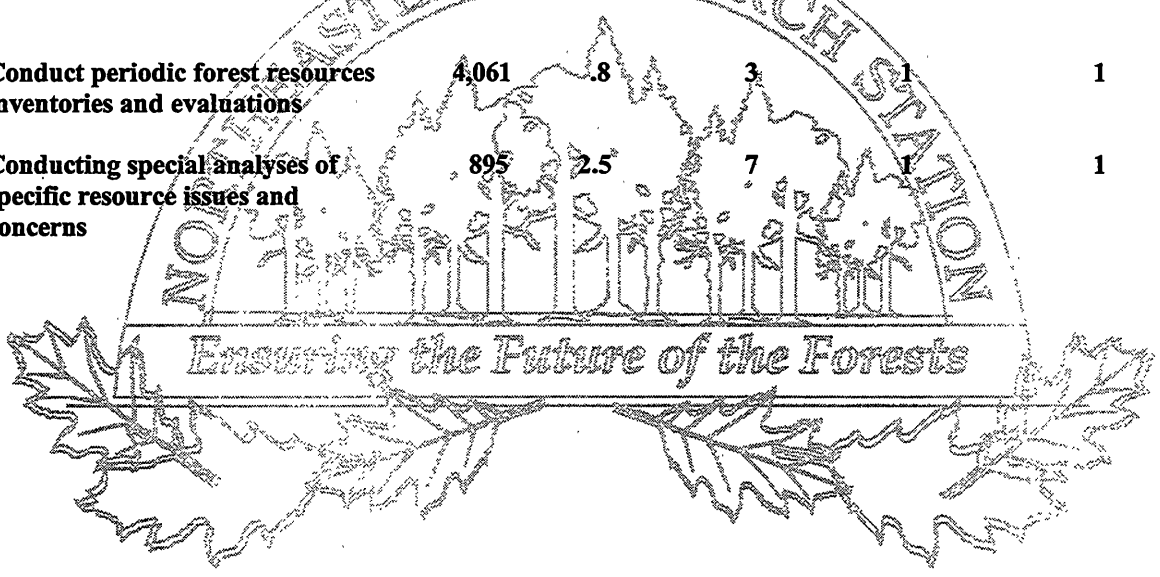
A study was conducted that developed the production and cost information for a mechanized cut-to-length (CTL) harvester used in a single-tree and group-selection cut in central Vermont. Results show that for trees whose average volume (size) was 7-18 cubic feet, production ranged from 464 to 734 cubic feet per productive machine hour (PMH). Production costs ranged from about $0.32 per cubic foot to $0.20 per cubic foot. Results suggest that CTL systems can be effective harvesting tools for Northeastern forests. The results should be valuable to forest planners and managers. Results of this research have been presented to resource managers, policy makers, loggers, and other researchers through publications, symposia, and other technology transfer efforts.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4801

Forest Inventory and Analysis
Scott, Charles T, Program Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Conduct periodic forest resources inventories and evaluations	4,061	.8	3	1	1
2. Conducting special analyses of specific resource issues and concerns	895	2.5	7	1	1



NORTHEASTERN RESEARCH STATION
Research Unit NE-4801

Problem 1 Conduct periodic forest resources inventories and evaluations

Publications

Research

Arner, Stanford L. 2000. Comparison of three annual inventory designs, a period design, and a midcycle update design. In: McRoberts, Ronald E.; Reams, Gregory A.; VanDeusen, comps., eds. Proceedings of the 1st annual forest inventory and analysis symposium; 1999 November 2-3; San Antonio, TX. Gen. Tech. Rep. NC-213. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station: 31. Abstract.

Chojnacky, D.C.; Jenkins, J.C. 2000. Allometric relationship between tree diameter and total aboveground biomass may be more species independent than previously thought. In: Ecological Society of America 85th annual meeting; 2000 August 6-9, Snowbird, UT. Washington. DC: Ecological Society of America: 73. Abstract.

Jenkins, J.C.; Birdsey, R.A. 1999. Validation databases for simulation models: biomass and net primary productivity (NPP) estimation using forest inventory data. In: Legacies, landscapes and limits: bridging borders: 84th annual meeting of the Ecological Society of America; 1999 August 8-12; Spokane, WA. Washington, DC: Ecological Society of America: 117. Abstract.

McWilliams, William H.; Heath, Linda S.; Reese, Gordon C.; Schmidt, Thomas L. 2000. Forest resources and conditions. In: Mickler, Robert A., Birdsey, Richard A.; Hom, John. comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 3-26.

Scott, Charles T. 2000. Pennsylvania forests: a new inventory. Pennsylvania Forests. 91(2): 19, 28.

Cooperative

McWilliams, William H.; Schmidt, Thomas L. 2000. Composition, structure, and sustainability of hemlock ecosystems in eastern North America. In: McManus, Katherine A.; Shields, Kathleen S.; Souto, Dennis R., eds. Proceedings: Symposium on sustainable management of hemlock ecosystems in eastern North America; 1999 June 22-24; Durham, NH. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 5-10.

Yorks, Thad E.; Jenkins, Jennifer C.; Leopold, Donald J.; Raynal, Dudley J.; Orwig, David A. 2000. Influences of eastern hemlock mortality on nutrient cycling. In: Proceedings symposium on sustainable management of hemlock ecosystems in eastern North America. Gen. Tech. Rep. NE-267. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 126-133.

Extramural

Irland, Lloyd C.; McWilliams, Will; Widmann, Rich. 2000. Forest of New Hampshire and Vermont 1983-1997. The Northern Logger and Timber Processor. 48(9): 8-9, 34-38.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4801

Attainment

The project is in the process of closing out periodic inventories. Field data collection was completed for Delaware and Maryland, while data continues to be collected in West Virginia. Data processing was completed for seven states: New Hampshire, Vermont, Connecticut, Massachusetts, Rhode Island, Delaware, New Jersey, and Maryland. Statistical reports were produced for all but Delaware and New Jersey. Planning is underway to produce analytical booklets and color brochures for these states - a brochure for New Hampshire has been completed.

The project is continuing with its efforts toward implementing the new annual inventory system for the Northeastern states. Data is being collected in Maine for the second year using new national protocols developed to achieve consistency in regional forest inventories. Tables were developed following completion of the first year's data collection. In addition, the new annual inventory system was implemented in Pennsylvania. A pilot study was initiated along with the new annual inventory in Pennsylvania to more fully access regeneration on Forest Inventory and Analysis field plots.

Efforts continue to meet specific user needs and technology transfer goals through presentations before public and private customers. A joint session was conducted between West Virginia state forestry personnel and the research unit to provide training for consultants funded through the Northeastern Area State and Private Forestry Stewardship program. Also disseminated was information addressing the major demographic and social aspects of private forest-land ownership; particularly as they apply to forest fragmentation, turnover of ownership, and public influence on the management of private forests.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4801

Problem 2 Conducting special analyses of specific resource issues and concerns

Publications

Research

Hershey, Rachel Riemann. 2000. Modeling the spatial distribution of ten tree species in Pennsylvania. In: H. Todd Mowrer and Russell G. Congalton, comps., eds. Quantifying spatial uncertainty in natural resources: theory and applications for GIS and remote sensing. Chelsa, MI: Ann Arbor Press: 119-135.

Jenkins, Jennifer C.; Kicklighter, David W.; Aber, John D. 2000. Regional impacts of climate change and elevated carbon dioxide on forest productivity. In: Mickler, Robert A.; Birdsey, Richard A.; Hom, John, comps., eds. Responses of northern U.S. forests to environmental change. Ecol. Stud. 139. New York, NY: Springer-Verlag: 383-424.

King, Susan L. 2000. Sequential Gaussian simulation vs. simulated annealing for locating pockets of high-value commercial trees in Pennsylvania. Annals of Operations Research. 95: 177-203.

King, Susan L.; Bennett, Kristin P.; List, Shannon. 2000. Modeling noncatastrophic individual tree mortality using logistic regression, neural networks, and support vector methods. Computers and Electronics in Agriculture. 27:401-406. Extended Abstract.

King, Susan Lynn. 2000. Using spatial statistics to locate trees with high commercial value. In: 7th symposium on systems analysis in forest resources; 1997 May 28-31; Traverse City, MI. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station: 42-50.

Lister, Andrew; Riemann, Rachel; Hoppus, Michael. 2000. Use of regression and geostatistical techniques to predict tree species distributions at regional scales. In: 4th international conference on integrating GIS and environmental modeling (GIS/EM4): problems, prospects and research needs; 2000 September 2-8; Banff, Alberta, Canada. Boulder, CO: University of Colorado: 1-10.

Luppold, William G.; McWilliams, William H. 2000. Pitfalls of interpreting hardwood inventory statistics. In: Munn, Ian A.; Bullard, Steven H.; Grado, Stephen C.; Grebner, Donald L., eds. Proceedings of the 1999 southern forest economics workshop: timberland investments: improving the odds.; 1999 April 18-20; Biloxi, MS. Mississippi State, MS: Mississippi State University: 232-235.

Riemann, Rachel; Tillman, Kathy. 1999. FIA photointerpretation in southern New England: a tool to determine forest fragmentation and proximity to human development. Res. Pap NE-709. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 12.

Cooperative

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NORTHEASTERN RESEARCH STATION
Research Unit NE-4801

Cooperative

Moeur, Melinda; Hershey Riemann, R. 2000. Preserving spatial and attribute correlation in the interpolation of forest inventory data. In: Spatial accuracy assessment: land information uncertainty in natural resources. Chelsea, MI: Ann Arbor Press: 419-429.

Extramural

Lister, Andrew J.; Mou, Paul P.; Jones, Robert H.; Mitchell, Robert J. 2000. Spatial patterns of soil and vegetation in a 40-year-old slash pine (Pinus elliotti) forest in the Coastal Plain of South Carolina, U.S.A. Canadian Journal of Forest Research. 30: 145-155.

Attainment

Phase I design: A variety of satellite image processing techniques continue to be evaluated for use in the production of phase I inventories. Improvements in accuracy occur when measurements of forest area complexity are incorporated into the stratification procedure, and when additional ancillary information is added to the forest nonforest maps.

Geostatistics: Considerable advances have been made over traditional geostatistical estimation procedures by combining ancillary information (satellite imagery, digital elevation information, urbanization metrics, etc.) with the georeferenced ground plot information. These procedures provide spatially continuous estimates of forest parameters in interplot regions.

Baltimore Forest/Nonforest Inventory: Forest inventories were expanded to cover urban forest land in a study affiliated with the Long-Term Ecological Site in the Baltimore metropolitan area. Field crews completed the ground survey, data were entered and analyzed, and initial estimates of tree density, species composition, and other parameters were attained. This research evaluates land not previously covered in traditional forest inventories.

Baltimore Urbanization: Forestland in five counties in the area within the Baltimore metropolitan area is being studied for the effect of urbanization on forest composition and structure. FIA ground plots have been selected from plots previously surveyed over the past fifty years to provide information on the relationship between forest change over time, forest type, and their proximity to urban features.

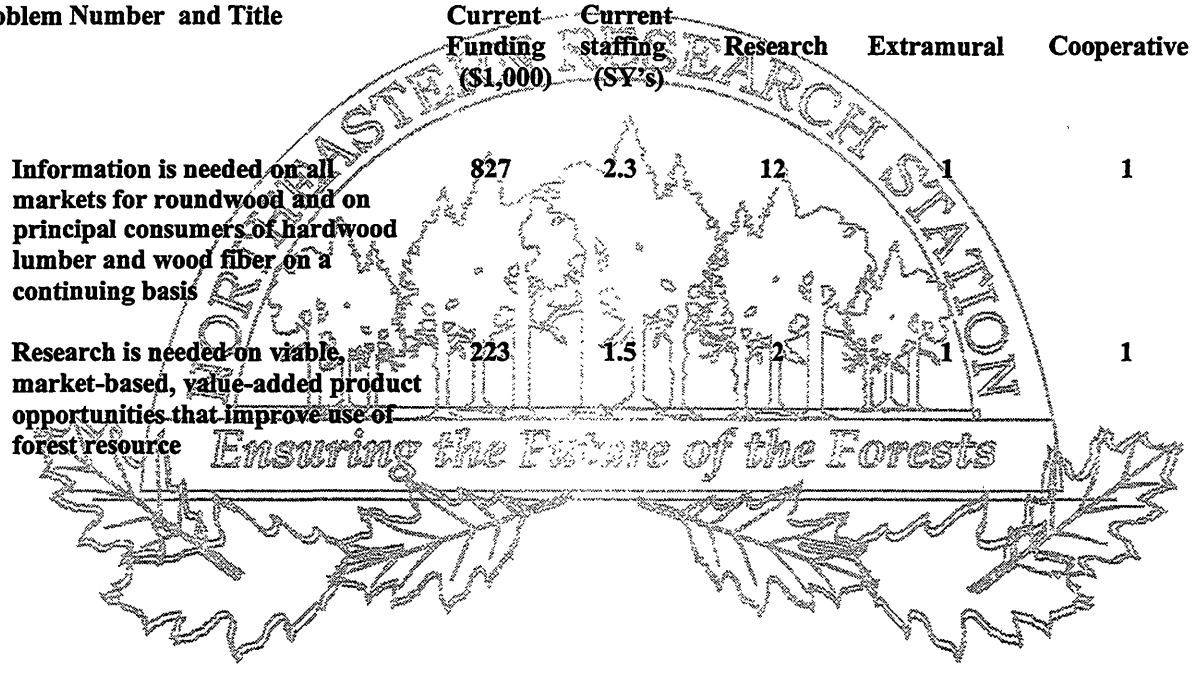
Data Distribution: Several enhancements to the FIA web page have been made, including an improved data distribution site, an updated description of our goals, mission, and current research projects, and a general revision and overhaul. Fine scale species distribution maps of 12 important species have been created for 9 of the most recently surveyed states, and are being prepared for distribution via the internet and incorporation into station publications.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4803

Economics of Eastern Forest Use
Hansen, Bruce G., Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Information is needed on all markets for roundwood and on principal consumers of hardwood lumber and wood fiber on a continuing basis	827	2.3	12	1	1
2. Research is needed on viable, market-based, value-added product opportunities that improve use of forest resource	223	1.5	2	1	1



NORTHEASTERN RESEARCH STATION
Research Unit NE-4803

Problem 1 Information is needed on all markets for roundwood and on principal consumers of hardwood lumber and wood fiber on a continuing basis

Publications

Research

Emanuel, David; Rhodes, Carol. 2000. Bulletin of hardwood market statistics: 1999. Res. Note NE-371. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 22.

Emanuel, David; Rhodes, Carol. 2000. Bulletin of hardwood market statistics: first half--99. Res. Note NE-370. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station: 22.

Hansen, Bruce G.; West, Cynthia D. 1999. Comparison of selected financial ratios for the pallet industry. In: Munn, Ian A.; Bullard, Steven H.; Grado, Stephen C.; Grebner, Donald L., eds. Proceedings of the 1999 southern forest economics workshop: timberland investments: improving the odds; 1999 April 18-20; Biloxi, MS. Mississippi State, MS: Mississippi State University. 301-306.

Hyldahl, Carol A.; Hansen Bruce G.; West, Cynthia D. 2000. An update of the hardwood chip market. In: Forest Products Society 54th annual meeting; 2000 June 18-21; South Lake Tahoe, NV. Madison, WI: Forest Products Society. 55. Abstract.

Olah, David F.; Smith, Robert L. 2000. Wood material use in the U.S. cabinet industry. In: Forest Products Society 54th annual meeting; 2000 June 18-21; South Lake Tahoe, NV. Madison, WI: Forest Products Society. 36. Abstract.

Schuler, Al. 2000. Demographics help explain the housing market. Woodwords. August: 36-37.

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Schuler, Al; Adair, Craig. 2000. Engineered wood products - production, trade, consumption and outlook. Timber Bulletin. 53: 131-146.

Schuler, Albert T.; Adair, Craig. 2000. Overcapacity in structural panels? Possible solutions to an age-old problem. In: Forest Products Society 54th annual meeting; 2000 June 18-21; South Lake Tahoe, NV. Madison, WI: Forest Products Society. 21. Abstract.

Schuler, Albert T.; Taylor, Russ; Araman, Philip A.; West, Cynthia D. 2000. International trade in furniture/fixtures - strategies for a competitive global business environment. In: Forest Products Society 54th annual meeting; 2000 June 18-21; South Lake Tahoe, NV. Madison, WI: Forest Products Society. 12. Abstract.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4803

Research

West, Cynthia D.; Jahn, Larry G.; Bumgardner, Matthew S.; Forbes, Craig L. 2000. Consumer perceptions of character-marks on eastern hardwood veneer and panels. In: Forest Products Society 54th annual meeting; 2000 June 18-21; South Lake Tahoe, NV. Madison, WI: Forest Products Society. 13. Abstract.

Cooperative

Sun, Xiufang; Hammett, A.L.; West, Cynthia D. 1999. Hardwood use in China's furniture industry. Forest Products Journal. 49(11/12): 51-59.

Extramural

Anonymous. 1999. Growing hardwood opportunities in Chinese furniture industry. Hardwood Research Bulletin. 511: 3-4.

Attainment

Hardwoods are being used increasingly in the manufacture of engineered wood products (EWP). Products such as oriented strandboard and structural composite lumber (laminated veneer lumber, parallel strand lumber, and oriented strand lumber) are opening up new markets for hardwoods creating new demands on the hardwood resource. Project scientists evaluated the current extent of EWP use and the volume of hardwood used in their manufacture. This information comprised the first ever chapter exclusively focused on EWP to be included in the United Nations ECE/FAO Annual Forest Product Market Review. Future studies will look at long-term growth expectations for EWP's in both residential and nonresidential markets and consequent impacts of EWP's on the hardwood resource and on "traditional" markets for hardwood.

China is a huge market with growing demands for all kinds of products including wood furniture. Results of an assessment of the role of the United States in supplying wood to the furniture industry in China found that most solid wood furniture is produced from domestic temperate species. Red oak from the United States is the most popular temperate import. Strategies for expanding U.S. exports call for selling kiln-dried hardwood to small and medium sized firms and wholesalers in Southern China. Project scientists also looked at the U.S. domestic furniture industry and competition from foreign manufacturers. Currently, one-third of the furniture consumed in the United States is imported. Parallels from the softwood moulding industry were used in suggesting strategies U.S. manufacturers might employ in dealing with competitors.

Project scientists conducted an analysis of hardwood chip mills, and hardwood chip production, consumption and exports at the request of the Washington Office. The study provided a comprehensive, factual, and nonjudgmental look at the chip mill industry.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4803

Problem 2 Research is needed on viable, market-based, value-added product opportunities that improve use of forest resource

Publications

Research

Bumgardner, Matthew S.; Bush, Robert J.; West, Cynthia D. 2000. Beyond yield improvement: selected marketing aspects of character-marked furniture. Forest Products Journal. 50(9): 51-58.

Hansen, Bruce; Araman, Phil; West, Cindi; Schuler, Al. 2000. Hardwood timber product markets: a focus on small-diameter. In: Proceedings of the Society of American Foresters 1999 national convention; 1999 September 11-15; Portland, OR. SAF Publ. 00-1. Bethesda, MD: Society of American Foresters. 305-311.

Cooperative

Bick, Steven; Haney, Jr., L.; West, Cynthia D. 1999. How conservation easements address forest values. In: Proceedings of the Society of American Foresters 1998 national convention; 1998 September 19-23; Traverse City, MI. SAF Publ. 99-01. Bethesda, MD: Society of American Foresters. 232-236.

Extramural

Anonymous. 2000. Pallet costing system is useful tool. Pallet Talk. (2): 18.

Attainment

Effective and maximum use of low-value, small-diameter (LVSD) hardwood timber has long been of interest to forest managers and researchers. In addition to being a significant component of the standing forest base, LVSD hardwoods often are available after thinning or other tending operations. Partially in response to a special CReating OPportunitieS (CROPS) grant from the Washington Office, we conducted several studies to assess the LVSD hardwood resource, look at past efforts to increase its utilization, and identify new opportunities that may be available today as a result of changing technology. It is generally believed that one size does not fit all, and that the solution to increasing LVSD use may require a mix of products targeted to specific resource and community parameters.

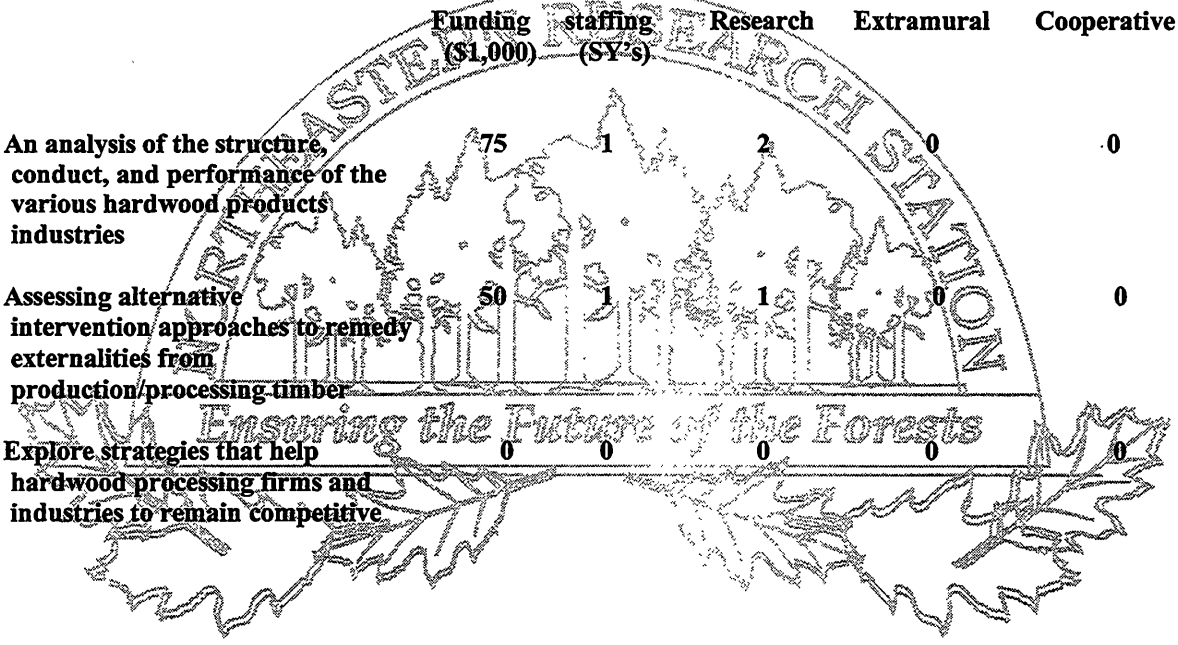
Work has continued in assessing the potential for use of "character" in secondary hardwood products. The results of a study of consumers attending a large home furnishings show indicated that a large group of consumers were insensitive to character in cabinet doors. Instead, most based their evaluations on the species of wood used. This suggests that opportunities may exist for increased use of character with little additional promotional effort. There was a small group of respondents that indicated that character was important to their evaluations. However, even for this group, character may be acceptable if limited to the use of small or subtle marks.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4805

Enhancing the Performance & Competitiveness of U.S. Hardwood Industry
Luppold, William George, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. An analysis of the structure, conduct, and performance of the various hardwood products industries	75	1	2	0	0
2. Assessing alternative intervention approaches to remedy externalities from production/processing timber	50	1	1	0	0
3. Explore strategies that help hardwood processing firms and industries to remain competitive	0	0	0	0	0



NORTHEASTERN RESEARCH STATION
Research Unit NE-4805

Problem 1 An analysis of the structure, conduct, and performance of the various hardwood products industries

Publications

Research

Luppold, William G.; Baumgras, John E. 2000. Impact of market-based disturbance on the composition of West Virginia's forest resource. In: Munn, Ian A.; Bullard, Steven H.; Grado, Stephen C.; Grebner, Donald L., eds. Proceedings of the 1999 southern forest economics workshop: timberland investments: improving the odds; 1999 April 18-20; Biloxi, MS. Mississippi State, MS: Mississippi State University: 193-199.

Luppold, William G.; McWilliams, William H. 2000. Pitfalls of interpreting hardwood inventory statistics. In: Munn, Ian A.; Bullard, Steven H.; Grado, Stephen C.; Grebner, Donald L., eds. Proceedings of the 1999 southern forest economics workshop: timberland investments: improving the odds.; 1999 April 18-20; Biloxi, MS. Mississippi State, MS: Mississippi State University: 232-235.

Attainment

The eastern hardwood resource is primarily controlled by private nonindustrial land owners while only 7 percent is controlled by the National Forest System (NFS). Although only a small amount of the hardwood timber is controlled by NFS, these timberlands contain a disproportionate share of the quality timber desired by industry. This difference in quality is an indicator of the difference in timber management. However, since 1985 NFS sales of hardwood sawtimber have steadily declined as the result of changing resource management priority. These declines have occurred in all eastern regions. As the high quality timber on NFS lands becomes less available, industry will seek greater quantities of quality timber on private lands. Unfortunately, these efforts usually result in the selective cutting of a few species without regard to future stand composition, structure, or quality making increased "high grading" an unintended result of reduced NFS sales. Current research efforts in this problem area include assessing the attributes of lands being disturbed by timber harvesting and how can we better inform private nonindustrial land owners of the silvicultural alternatives available to them. It is hoped that identification of lands that have the greatest likelihood of being harvested in combination with informing owners of these lands of the silvicultural alternatives will reduce high grading and improve long term forest sustainability.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4805

Problem 2 Assessing alternative intervention approaches to remedy externalities from production/processing timber

Publications

Research

Luppold, William G.; Baumgras, John E. 2000. Analysis of changes in eastern national forest timber sales between 1985 and 1997. Forest Products Journal. 50(1): 87-93.

Attainment

The product manufactured by and the structure of the hardwood industry is a function of the available resource. Ironically, future forest structure and composition are affected by the way today's industry removes timber from the forest. For instance, during the late 19th and early 20th century much of the hardwood resource available to industry was large diameter old growth. The abundance of this material allowed large sawmills to produce huge quantities of higher-grade hardwood lumber. Once the old growth was cut, sawmill size decreased because the residual resource was insufficient to support large mills. The harvesting practices used during the late 19th and early 20th century combined with fire, drought, disease, and other factors helped shape the abundant forest resource of today. In turn, this abundant resource in combination with a superior transportation system has enabled sawmill size to increase. Past history has taught us that understanding the interrelationship between the hardwood industry and resource is important in accessing future forest composition, structure, and sustainability. To understand this interrelationship we must examine how hardwood forests are changing with changing timber and fiber demand. This examination not only included conventional demand analysis but analysis of forest inventory data. However, inventory data is easily misinterpreted by people who do not fully comprehend how the data is collected and the exact meaning of specific terms. For instance, understanding that the term growing stock does not include cull trees and other bio mass that can be used by the increasing important hardwood fiber industry is paramount in understanding the impact of this emerging industry on future forests.

Research in this problem area has been curtailed as researchable problems in problem areas 1 and 2 have been integrated into publications developed for problem area 2.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4805

Problem 3 Explore strategies that help hardwood processing firms and industries to remain competitive

Attainment

Research in this problem area has been curtailed as important researchable problems in areas 1 and 2 are being completed.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4952

Effects of Urban Forests and their Management on Human Health and Environmental Quality
Nowak, David J, Project Leader

FY 2000 Research Attainments
Research Unit Summary

Problem Number and Title	Current Funding ($1,000)	Current staffing (SY's)	Research	Extramural	Cooperative
1. Measure the structure and health of urban forests, their variation across the United States, and change through time	84	0	0	0	1
2. Assess how urbanization is affecting the structure, function, and health of forests within and around urban areas	412	2.3	12	0	0
3. Quantify the net effects of urban forest structure and its management on the environment and human health	218	1.5	9	3	1
4. Develop management tools and guidelines that can be used to optimize the environmental benefits of urban forests to improve human health and environmental quality in and around urban areas	150	5	2	1	0

NORTHEASTERN RESEARCH STATION
Research Unit NE-4952

Problem 1 Measure the structure and health of urban forests, their variation across the United States, and change through time

Publications

Cooperative

Dwyer, John F.; Nowak, David J. 2000. A national assessment of the urban forest: an overview. In: Proceedings of the Society of American Foresters 1999 national convention; 1999 September 11-15; Portland, OR. SAF Pub. 00-1. Bethesda, MD: Society of American Foresters: 157-162.

Attainment

A national assessment of urban forests was completed and it is currently in press. A summary of the assessment was published to present a general overview of the findings. This assessment was the first ever conducted related to urban forests and will provide background information to help guide future policies and programs for sustaining the structure, function, and benefits of urban forests. The key attributes of urban forests that emerged from the assessment are their significance, diversity, connectedness, and dynamic character. Urban forest cover has been shown to be large and expanding. Approximately 3.5% of the conterminous United States is classified as urban and this area has doubled between the late 1960s and early 1990s. Urban tree cover, which averages 27% nationally, varies regionally with the total number of trees in U.S. urban forests estimated at 3.8 billion. These basic structural data provide critical baseline data on urban forest cover across the United States and are an essential element in understanding urban forest structure and variation across the United States.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4952

Problem 2 Assess how urbanization is affecting the structure, function, and health of forests within and around urban areas

Publications

Research

Belt, Kenneth T.; Groffman, Peter M.; Fisher, Gary T.; Band, Lawrence E. 2000. Stream chemistry patterns along an urban rural gradient. In: Communicating and advancing ecology: the Ecological Society of America 85th annual meeting; 2000 August 6-10; Snowbird, UT. Washington, DC: The Ecological Society of America: 390. Abstract.

Belt, Kenneth T.; Groffman, Peter M.; Fisher, Gary T.; Band, Lawrence E. 2000. Stream chemistry patterns along an urban-rural gradient: preliminary results from the Baltimore Ecosystem Study, an Urban LTER (Long-Term Ecological Research) site. In: Abstracts of American Geophysical Union spring 2000 meeting; 2000 May 30-June 3; Baltimore, MD. EOS Suppl. May 9 issue: S185-186. Abstract.

Belt, Kenneth T.; Pickett, Steward T.A.; Groffman, Peter M. 1999. New results from the Baltimore Ecosystem Study (BES): integrated long-term ecological research in an urban environment. In: Program and abstracts: Maryland Water Monitoring Council 5th annual meting; 1999 November 12; Linthicum, MD. Baltimore, MD: Maryland Department of Natural Resources, Maryland Geological Survey. Abstract.

Carreiro, M.M.; Howe, K.; Parkhurst, D.F.; Pouyat, R.V. 1999. Variation in quality and decomposability of red oak leaf litter along an urban-rural gradient. Biology and Fertility of Soils. 30: 258-268.

Pouyat, Richard V.; Effland, William R. 1999. The investigation and classification of humanly modified soils in the Baltimore Ecosystem Study. In: Kimble, J.M.; Ahrens, R.J.; Bryant, R.B., eds. Classification, correlation, and management of anthropogenic soils: 1998 September 21-October 2; NV and CA. Lincoln, NE: U.S. Department of Agriculture, NRCS, National Soil Survey Center: 141-154.

Pouyat, Richard V.; Pickett, Steward T.A. 2000. A multidisciplinary approach to the study of urban ecosystems: the Baltimore Ecosystem Study. In: Abstracts of American Geophysical Union spring 2000 meeting;. 2000 May 30-June 3; Baltimore, MD. EOS Supple. May 9 issue: S11. Abstract.

Pouyat, Richard V.; Zipperer, Wayne C. 1999. Protecting forests in urbanizing landscapes: is it possible? In: Kollin, Cheryl, ed. Building cities of green: proceedings of the 1999 national urban forest conference; 1999 August 31-September 3; Seattle, WA. Washington, DC: American Forests: 96-100.

Pouyat, Richard, comp., ed. 2000. The Ecological Society of America. 2000. Acid deposition: the ecological response. A workshop report; 1999 March 1-3; Washington, DC; Washington, DC: The Ecological Society of America. 23p.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4952

Research

Szlavecz, Katalin; Pouyat, Richard V.; Groffman, Peter M.; Lorefice, Alan. 2000. The effect of urbanization on forest soil communities. In: Final program, 51st annual meeting of the American Institute of Biological Sciences. Biology: challenges for the new millennium; 2000 March 22-24; Washington, DC; [Place of publication unknown]: American Institute of Biological Sciences: 30-31. Abstract.
Tague, Christina; Band, Larry; Groffman, Peter; Belt, Ken. 2000. Spatially distributed modelling of the hydro-geologic and ecologic controls on nitrogen cycling and nitrate export for a small forested watershed. In: Abstracts of American Geophysical Union spring 2000 meeting; 2000 May 30-June 3; Baltimore, MD. EOS Supple. May 9 issue: S185. Abstract.

Zipperer, Wayne C. 2000. Ecosystem management in urban landscapes: is it possible? In: Communicating and advancing ecology: the Ecological Society of America 85th annual meeting; 2000 August 6-10, Snowbird, UT. Washington, DC: The Ecological Society of America: 38. Abstract.

Zipperer, Wayne C.; Wu, Jianguo; Pouyat, Richard V.; Pickett, Steward T.A. 2000. The application of ecological principles to urban and urbanizing landscapes. Ecological Applications. 10(3): 685-688.

Attainment

Cities can affect the quality of leaf litter, through increased air pollution, changes in the biotic community, and altered local climates. Research results indicate that leaf litter from forests in urban areas decompose more slowly than leaves from more rural stands and have an altered chemical structure. These changes suggest altered nutrient cycling with urban stands that may consequently affect forest health. A proposed conceptual framework was also introduced that would include human modification of soils as a factor of soil formation. This new framework can facilitate a better understanding of how urbanization affects soil structure and chemistry and also affects urban tree health and survivability.

NORTHEASTERN RESEARCH STATION
Research Unit NE 4952

Problem 3 Quantify the net effects of urban forest structure and its management on the environment and human health

Publications

Research

Brazel, Anthony J.; Heisler, Gordon M. 2000. Some considerations in using climate data from existing weather stations or installing stations for research in Baltimore and Phoenix urban LTER sites. In: 3rd symposium on the urban environment; 2000 August 14-18; Davis, CA. Boston, MA: American Meteorological Society: 187-188.

Civerolo, K.L.; Sistla, G.; Rao, S.T.; Nowak, D.J. 2000. The effects of land use in meteorological modeling: implications for assessment of future air quality scenarios. Atmospheric Environment. 34: 1615-1621.

Grant, R.H.; Heisler, G.M. 1999. The adaptation of UV forecasts to typical human environments: the UV shade index. Photochemistry and Photobiology. 69: 56S. [Suppl. Photochemistry and Photobiology. 70(1)]. Abstract.

Grant, Richard H.; Heisler, Gordon M. 2000. Estimation of Ultraviolet-B irradiance under variable cloud conditions. Journal of Applied Meteorology. 39: 904-916.

Grant, Richard H.; Heisler, Gordon M.; Slusser, James R. 2000. Urban UV measurements: rationale for the establishment of long-term monitoring in the Baltimore Ecosystem Study. In: 3rd symposium on the urban environment; 2000 August 14-18; Davis, CA. Boston, MA: American Meteorological Society: 195-196.

Heisler, Gordon M.; Groffman, Peter M.; Band, Larry; Belt, Kenneth; Fabiyi, Vicki; Fisher, Gary T.; Grant, Richard H.; Grimmond, Sue. 2000. A reference meteorological station for urban long-term ecological research, Baltimore Ecosystem Study. In: 3rd symposium on the urban environment; 2000 August 14-18; Davis, CA. Boston, MA: American Meteorological Society: 189-190.

Heisler, Gordon, M.; Grant, Richard H. 2000. Ultraviolet radiation, human health, and the urban forest. Gen. Tech. Rep. NE-268. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeasten Research Station: 35.

Nowak, David J. 2000. Impact of urban forest management on air pollution and greenhouse gases. In: Proceedings of the Society of American Foresters 1999 national convention; 1999 September 11-15; Portland, OR. SAF Publ. 00-1. Bethesda, MD: Society of American Foresters: 143-148.

Nowak, David J.; Civerolo, Kevin L.; Rao, S. Trivikrama; Sistla, Gopal; Luley, Christopher J.; Crane, Daniel E. 2000. A modeling study of the impact of urban trees on ozone. Atmospheric Environment. 34: 1601-1613.

Cooperative

Nowak, David J.; Dwyer, John F. 2000. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, John E., comp., ed. Handbook of urban and community forestry in the Northeast. New York, NY: Kluwer Academic/Plenum Publishers: 11-25.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4952

Extramural

Grimmond, C.S.B.; Oke, T.R. 1999. Aerodynamic properties of urban areas derived from analysis of surface form. Journal of Applied Meteorology. 38: 1262-1292.

Grimmond, C.S.B.; Oke, T.R. 2000. Heat fluxes and stability in cities. In: 3rd symposium on the urban environment; 2000 August 14-18; Davis, CA. Boston, MA: American Meteorological Society: 28-29.

Ning, Zhu H.; Abdollahi, Kamran K. 1999. In: Global climate change and its consequences on the Gulf Coast Region of the United States. Baton Rouge, LA: Franklin Press, Inc. and GCRCC: 98.

Attainment

Modeling the effects of increased urban tree cover on ozone concentrations (July 13-15, 1995) from Washington, DC to central Massachusetts reveals that urban trees have a locally positive effect by reducing ozone in urban areas of the Northeast, but tend to increase overall regional ozone concentrations. During the daytime, local ozone reductions (1 ppb) due to increased urban tree cover are greater than the overall regional ozone increases (0.26 ppb). Increasing urban tree cover from 20 to 40% led to an average decrease in hourly ozone concentrations in urban areas during daylight hours of 1 ppb (2.4%) with a peak decrease of 2.4 ppb (4.1%). The physical effects of vegetation changes on ozone concentrations also appear to be more important than atmospheric chemical interactions with biogenic volatile organic compound (VOC) emissions from urban trees in the Northeast. Pollutant deposition to trees has a significant impact on reducing ozone levels, but this effect is diminished as the depth of the boundary layer increases. Pollutant deposition of NOx tends to increase nighttime ozone concentrations due to the loss of NOx scavenging of ozone. The effect of trees on reducing horizontal wind speed tends to increase ozone concentrations both locally and regionally due to diminished pollutant dispersion in the atmosphere. Shifting to low VOC emitting tree species had little impact on ozone concentration (< 1 ppb), but use of low emitting species could still help reduce ozone levels in some urban areas. Modeling results indicate that increasing urban tree cover in non-attainment areas of the Northeast is a viable strategy to help reduce local ozone levels, but may also lead to slight overall increases in ozone concentrations in surrounding areas.

NORTHEASTERN RESEARCH STATION
Research Unit NE-4952

Problem 4 Develop management tools and guidelines that can be used to optimize the environmental benefits of urban forests to improve human health and environmental quality in and around urban areas

Publications

Research

Heisler, Gordon M. 2000. Review of "The urban forest: comprehensive management." Natural Areas Journal. 20(1):91.

Nowak, David J.; Crane, Daniel E. 2000. The urban forest effects (UFORE) model: quantifying urban forest structure and functions. Hansen, Mark; Burk, Thomas, eds. In: Integrated tools for natural resources inventories in the 21st century: proceedings of the IUFRO conference; 1998 August 16-20; Boise, ID. Gen. Tech. Rep. NC-212. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 714-720.

Extramural

Hoover, Anne P.; Shannon, Margaret A. 1995. Building greenway policies within a participatory democracy framework. Landscape and Urban Planning. 33: 433-459.

Attainment

The Urban Forest Effects (UFORE) computer model was developed to help managers and researchers quantify urban forest structure and functions. The model quantifies species composition and diversity, diameter distribution, tree density and health, leaf area, leaf biomass, and other structural characteristics; hourly volatile organic compound emissions (emissions that contribute to ozone formation) throughout a year; total carbon stored and net carbon sequestered annually; and hourly pollution removal by the urban forest and associated percent improvement in air quality throughout a year. Results of field data and model analyses reveal that trees in New York store approximately 1.2 million metric tons of carbon. This carbon, which took years to store, is equivalent to the amount emitted from New York's population in about 10 days based on average per capita carbon emissions. New York's trees sequester an estimated 39,000 t C yr-1. In 1994, trees in New York City removed an estimated 1,821 metric tons of air pollution at an estimated value to society of $9.5 million. Air pollution removal by urban forests in New York was greater than in Atlanta and Baltimore, but pollution removal per m2 of canopy cover was fairly similar among these cities (New York: 13.7 g m-2 yr-1; Baltimore: 12.2 g m-2 yr-1; Atlanta: 10.6 g m-2 yr-1). Air quality improvement in New York due to pollution removal by trees during daytime of the in-leaf season averaged 0.47% for PM10, 0.45% for O3, 0.43% for SO2, 0.30% for NO2, and 0.002% for CO. In urban areas with 100% tree cover (i.e., contiguous forest stands), short-term improvements in air quality (one hour) from pollution removal by trees were as high as 15% for O3, 14% for SO2, 13% for PM10, 8% for NO2, and 0.05% for CO.

PART II: BIBLIOGRAPHY

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